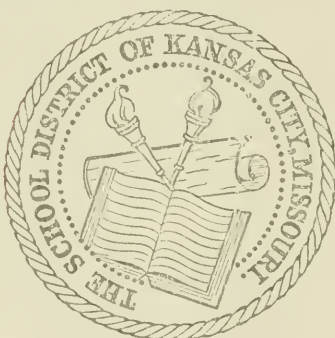




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TELEPHONE QUARTERLY

*VOLUME VIII, 1929*



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# BELL TELEPHONE QUARTERLY

VOLUME VII, 1929

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# BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION  
AND A RECORD OF PROGRESS

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## Communication

*Address of Walter S. Gifford, President of American  
Telephone and Telegraph Company. Before the  
Conference of Major Industries New York,  
October 24, 1928.*

FROM the earliest civilizations of which we have record until well after the formation of the United States the communication art remained practically the same. It depended essentially on the speed of man or horse and sailboat, with here and there the limited use of beacon and smoke signals or semaphores. Then suddenly, early in the last century, came a sudden and dramatic change.

Let me read to you a sentence or two from that delightful New York diarist, Philip Hone. On June 2, 1841, he writes:

“At eleven o'clock yesterday the President sent in his message to Congress. The rapidity with which the message was brought on by the railroad exceeds all precedent; it absolutely seems like flying. It left Washington at three minutes before twelve o'clock

noon and was in the City of New York at half-past nine last evening."

Five years later Hone was presiding over the Whig convention at Utica to nominate a candidate for governor of New York. This is what he records in his diary:

" 'Magnetic telegraph.' Strange and wonderful discovery which has made the 'swift-winged lightning' man's messenger, annihilated all space and tied the two ends of a continent in a knot! The whole extent of the newly discovered phenomenon was never made so apparent to me as on the day of the meeting of the convention; during the hour of adjournment to dinner a message was sent by telegraph to Mr. Fillmore at Buffalo. The answer came immediately that 'Mr. Fillmore was not in his office, and could not be found.' Soon after, another communication was received, authorizing the withdrawal of his name. . . . This was handed to me on my taking the chair, and had travelled 470 miles during our short recess of an hour."

When Hone recorded the increasing speed of communication by train he recorded a change in the degree of speed, but when he recorded the use of the electric telegraph he recorded a change in kind—the basis of a new civilization—one based on instantaneous communication in politics, commerce, and the social contacts of life. Electrical communication is one foundation of the complete alteration in the habits of mankind, for without rapid communications neither the spread of modern knowledge nor the control and organization of modern industry would be possible. Control of time is one of the essentials that differentiate our civilization from any that preceded and modern communication gives to the ordinary man almost unlimited facilities for the control of time and space and the interchange of ideas.

Today, an individual located practically anywhere in the United States has at his command day and night—Sundays and holidays included—instrumentalities for immediate intercommunication with almost any one anywhere in the civilized world. On an average, in less

than a minute he can call up and talk by telephone with any one in his community, which means in a community the size of New York that he can almost instantly reach any one of one and one-half million telephones and that means several million people. In less than five minutes, in most cases, he can talk by telephone with practically any one of 19 million telephones wherever located in the United States, and their location is such that he can reach over those telephones nearly any one in the whole country. In addition, he can, if he has occasion to do so, talk to any of over 7 million foreign telephones which means that he can reach 80 percent of the telephones in the world. Within the reach of his voice are Canada, Cuba, Mexico, Great Britain, France, Germany, Spain, Belgium, Holland, Switzerland, Denmark, Norway, Sweden and Danzig. He can, over the same instrument and without moving out of his seat, send a message—a telegram, cable or radiogram—to anybody anywhere in the United States or, for that matter, practically anywhere in the civilized world, including ships at sea. He can send money by telegraph.

If he lives in New York or in one of several other larger cities in the United States, he can, where absolute accuracy is paramount or design important, speed a facsimile message or a picture by wire to distant cities of the United States. If, for example, he is distant from home and requires funds, his bank may arrange to extend unlimited credit and even signatures and identifying photographs by wire. He may rush a power of attorney from Boston to Atlanta for use this afternoon or send a bond circular in facsimile and have it distributed in Los Angeles in a few minutes. If his business is such that it has branch offices in several cities, they may be permanently linked by private telephone or telegraph circuits of which he has exclusive use, with the result that he may carry on his business as though his branch houses were all located within a city block. The messages that he sends from one



branch to another can, if desired, be sent over a typewriter so that a message typed in his office will be typed simultaneously in his branch office or offices. He may hold conferences by telephone at which the groups of people conferring are located in different parts of the country.

His telephone conversations are almost instant, and his written messages—telegrams, cables or radiograms, will usually be delivered and even replies received within a very short time—at the most it is a matter of hours. Obviously, this has made it possible to distribute the parts of an industry geographically so that they may be carried on most effectively without losing centralized management.

So far I have been speaking of one individual's getting in touch with another, but communication has also a general as well as an individual aspect. An event of importance happening anywhere in the world is known immediately throughout the United States and published promptly in the newspapers. The vast network of press wires that distributes this information throughout the country is an essential part of our business, governmental and social life. We are even so eager for speed that in some cases we do not wait for newspapers but we stand at a tape which records electrical impulses sent over a wire and gives us market quotations.

Not so long ago men cried their wares in the streets reaching customers perhaps a block away. Now men cry their wares over the radio reaching customers across a continent. Millions of people listen in their homes to the news, to good music, to the speeches of political leaders and, incidentally, are reminded of products of national distribution. In a very short time this combination has become an essential part of the social and commercial life of the nation.

A few years ago a speaker's audience was limited by the range of his voice. Thanks to the microphone and loud speakers, a man can now talk to an audience of

100,000 or more people immediately before him, and his words carried over wires to broadcasting stations and spread through the air reach millions more. Where the American people once judged the candidates for public office largely by rumor, reputation and reported statement, they are now able to weigh the candidate's actual words and the very tones of his voice.

Moreover, it is scientifically possible that these millions more scattered over the country might see the speaker in action, for the development of television makes it possible not only to hear but to see at a distance. I said purposely that this was scientifically possible. It is not yet commercially practical and often it takes a long period to change scientifically possible into commercially useful. In this case the road ahead may well be long and hard.

Radio has been used for more than twenty years for intercommunication. The advent of radio broadcasting, however, would seem to have resulted in confusion in the public mind about the relation of radio and wires. The public's attention, instead of being directed toward the satisfactory and prompt transmission of communications, has been focused on the means by which such transmission is achieved. Those of us in the business of communication have always been engaged in trying to find and employ the best and most economical means and to extend its range. From its very nature, radio is not and cannot be a substitute for intercommunication by wire. Radio, however, has been and will continue to be of great importance. It has widened the range of communications. It is useful in communicating long distances over large bodies of water, it is of inestimable worth in the broadcasting of news, music and entertainment, and it makes possible communication where wires cannot be used, such as with ships and aeroplanes. It would be unfortunate if the idea should become crystallized that radio and wires, broadly speaking, are competitive. They are essentially complementary, and

must be so considered if we are to have the best and cheapest intercommunication.

Progress in communications has been due in large part to organized research undertaken by the communications industry in this country. From such organized effort have come such recent extensions of the usefulness of communication as rapid long distance telephony; the dial telephone for large cities—a development which a few years ago even the most astute engineers thought beyond the bounds of the attainable; multiplex telephony and telegraphy based on frequency separation—a development which has made one circuit do the work of many; the sending of pictures by wire and radio; high-speed loaded submarine telegraph cables; deep-sea telephone cables; practically all of the present day technique of radio, not to mention collateral developments such as the orthophonic victrola, the talking movie, devices for measuring deafness and ameliorating its effects, and television apparatus.

By refinements and new applications of the art we shall extend the services of rapid communication to more and more people and make its services more and more useful to those who already have them. And this process happily is not haphazard. It is not dependent upon luck. Continued improvement is guaranteed by systematic research and development.

Already on the basis of present scientific knowledge, except for the prohibitive cost, every person in the world—whether on land, sea or in the air—could be brought into instantaneous intercommunication. All the millions of the world's population are scientifically within sight and sound of each other. But even if universal, world-wide, instantaneous communication were commercially practical there remain two obstacles. One is the backward state of part of the world's population to whom rapid communication is of little value since they have little to communicate, and the other is the fact that while half the world is blessed with

the light of day the other half is asleep. Modern civilization may in time stir the backward races to wants and abilities that will make them need electrical communication, but so far as I am aware, not even the research staffs have the temerity to tackle the problem of making the sun shine on both sides of the world at once.

This continued spread of rapid communications has already had a marked effect upon mankind. The ultimate economic, social and political results of the progressive elimination of time and distance in communication will be of profound importance.

In the field of industry, it vastly adds to the possibilities of increased production with less labor, thus tending toward a constantly better standard of living for all. In its social aspects it increases the extent of an individual's interests and contacts with others and adds to the richness and enjoyment of life. In its political aspects it tends toward a better and clearer understanding that makes for permanent peace.

The communications industry, although not the only agency, is a most important one in developing a world civilization tending to be independent of environment and tolerant of differences of race and culture. Already the products and inventions of the whole world and the thoughts and experiences of all civilized people are almost immediately brought within the knowledge of all. Never before has the world of men been changing so rapidly as now. In considerable part because electrical communications have been developed in western civilization, that civilization is spreading throughout the world for good or bad more rapidly than any civilization in history has ever spread before. From the fact that the civilized world is becoming one large neighborhood should result the satisfaction that comes from co-operation rather than the misery that comes from conflict.

Communication, however crude, has always been of service to mankind. From the earliest days the bearer



of messages has had the spirit of the Message to Garcia. The pony express rider would risk his life to get through. That spirit is still in the profession of communications. And it should be now more than ever, for this civilization of ours depends upon fast and certain communication as no other has before it. No people could harness the powers of nature to serve them as we have unless they, at the same time, organized men to manage them. This modern organization of men, this industrial society of ours, could not exist without electrical communication. The telegraph handles about 1,000,000 messages a day, and the telephones of the United States 75,000,000 a day. The precision of modern business requires these rapid services. The enlargement of men's capacities is dependent on the number of their fellows with whom they can have contact. Without electrical communication their number would not be large enough to make possible our present civilization.

Electrical communication is more highly developed in the United States than in any other country. The communication industry takes pride in the service it renders the nation. But that pride does not prevent recognition of the conditions which have made its rapid—its revolutionary—growth possible. Those conditions consist of a public competent and eager to use any facility that is offered, and a political system capable of evolving the purely American system of regulatory commissions which protect the public's interest but leave to the companies initiative and freedom of action to manage to the best of their abilities the services they render the public.



# Standardization in the Bell System

## *Introductory Note*

**I**N connection with a comprehensive study of industrial standardization, the National Industrial Conference Board recently requested a description of the processes of standardization in the Bell System and the results obtained.

Such a description, of course, bears upon the activities of all parts of the Bell System and therefore a statement was prepared through the co-operation of representatives of the various general departments of the American Telephone and Telegraph Company, the Bell Telephone Laboratories, and the Western Electric Company.

With the permission of the National Industrial Conference Board the substance of the paper thus prepared will be published in the Bell Telephone Quarterly. The first part is given below and the rest will follow in a later issue.

In view of the large number of people who assisted in the preparation of this statement it is hardly practicable to make specific acknowledgment to all contributors, but the undersigned, who acted as editor, wishes to acknowledge particularly the co-operation of Mr. S. P. Grace, Bell Telephone Laboratories; Mr. T. K. Stevenson and Mr. F. Clark, Western Electric Company; and Mr. F. L. Rhodes, Development and Research Department, American Telephone and Telegraph Company.

H. S. OSBORNE.

## GENERAL STATEMENT

The ideal and aim of the Bell System, as regards telephone service, is "A telephone service for the nation, so far as humanly possible free from imperfec-

tions, errors or delays, and enabling at all times anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

In order that it may most effectively work toward this ideal, the Bell System has been organized to do practically everything connected with giving such a telephone service, from the purchase of raw materials to the actual rendering of the service. Through the various companies and departments which constitute the System it does fundamental research work, investigates operating problems and develops operating methods, designs new apparatus to take advantage of the results of the research work and investigations, manufactures the apparatus in quantity, installs it as needed to meet service requirements, and operates and gives service with the plant so provided, using the methods so developed.

With this organization it is, of course, obvious that with far-sighted management the Bell System should seek to make the greatest possible use of standards for its plant and practices, and should seek also to have the number of different standards as small as is consistent with meeting adequately the service requirements of the System, in order to obtain the advantages in both service and economy which result. Standardization is therefore one of the firm bases on which the Bell System is built and is to a large extent responsible for the results which have been obtained.

Standardization in the Bell System is more than a means of obtaining economy and efficiency. It is essential to the best service and the most rapid progress. Standards are developed as the result of the accumulated experience of the operating companies and of the work of several thousand people at headquarters whose entire time is devoted to improvements. The results of the analysis of the operating experience and of the general investigations, researches, developments and

designs of the headquarters groups, crystallized in the form of operating practices, methods, types of apparatus and of communication systems, are made available at once to the operating telephone companies of the System throughout the country, with information regarding their desirable field of use. These types of apparatus, communication systems, methods and practices thereby become standards for the Bell System by virtue of the fact that they represent the outcome of adequate studies of the best way to meet a type of situation, and as such they are adopted by the operating companies and put into use to the extent that they are needed under the different conditions of different companies. In some cases the new standards as developed cover a new field of operating requirements or present the means for doing something which could not be done before. In many cases the new standards replace existing standards due to advances in the art, improvements in technique or changes in operating requirements. Standardization is therefore not a static thing but is dynamic, involving a continuous procession of new standards to meet new conditions or to meet old conditions better than was heretofore possible, and the consequent dropping of old standards.

In the Bell System the standardizing functions are distributed through various companies and departments.

The headquarters' forces, consisting of the general departments of the A. T. & T. Co. and the Bell Telephone Laboratories, are as noted above devoted to working out and standardizing improvements in telephone plant, methods, and operating practices covering the entire field of telephone work. This includes fundamental research work, the development, design and specification of apparatus and of systems of communication, the development of standard methods of test, construction and maintenance practices, methods of

handling telephone traffic, business methods and provisions for safety and health.

The Western Electric Company, which manufactures, purchases, and distributes for the Bell System, is, of course, very much concerned with standardization. A great deal of its manufacturing work consists in the quantity production of standardized products, and this facilitates the use of standardized manufacturing processes. In the stocking and distribution of apparatus and materials, standardized methods have been highly developed. This is also true in the installation of central office equipment, which is largely carried out by the Western Electric Company.

The telephone plant throughout the country is operated by a group of 24 Associated Operating Companies. Through the close co-operation between these companies and the headquarters' forces, full advantage is taken of their field experience in the determination and standardization of the best methods and practices in all matters bearing on the quality of the telephone service, including the design, construction and operation of plant, business methods and provisions for safety and for the health of employees.

To a large extent the standardizing work of the Bell System deals with matters peculiar to its own problems and is carried on within the System. The various parts of the Bell System are, however, taking very active part in co-operation with numerous national organizations engaged in standardizing work, in the development of standards which have a broader application than within the Bell System itself.

The various activities indicated in the foregoing are briefly discussed in the following pages.

#### STANDARDIZATION IN THE DESIGN OF TELEPHONE PLANT

The nature of the telephone business is such that the telephone system offers a very good example of the advantages of standardization of plant and equipment.



Telephone plant installed everywhere throughout the country must be such as to give satisfactory service when operated in connection with apparatus in any other part of the country. The plant of the telephone system is necessarily very complex in view of the complicated technical functions which it must successfully perform, the intricacy of the switching operations required for the rapid establishment of a connection between any two telephones in the country, and the complexity of the electrical transformations necessary to transmit and reproduce speech clearly between these telephones.

The complexity of the telephone plant and the number of types of apparatus and material which would be required would be very greatly multiplied if there were not a high degree of standardization for all parts of the telephone plant. In fact, it is not an exaggeration to say that the telephone service of today could not be given without this high degree of standardization.

As a result of standardization the telephone plant includes very large numbers of identical units of apparatus. This, of course, has numerous advantages. The use of very large numbers of standard types of apparatus, circuits and equipment results in large economies in production. For example, about 1,500,000 receivers and 1,500,000 telephone transmitters, each of a single type, are produced in a year. Also, about 2,500,000 relays of the "E" type, differing only in the details of assembly of standard piece parts, are produced annually, and of these about 239,000 are of one code number and 232,000 of another code number, the relays of a given code number being identical. Without standardization these same quantities would be distributed between a large number of different types with correspondingly greater costs. The advantages of using in the telephone plant large numbers of identical pieces of apparatus, of course, extend beyond production and

include stocking, construction, maintenance and operation.

In all standardization of apparatus, interchangeability has always been a prime consideration. This is important from the standpoint of dimensions; for example, transmitters are so designed as to fit into any mounting even though made a good many years apart. In a broader sense, considerations of interchangeability lead to the design of new standards in such a way as to fit into existing plant with the minimum possible change in the other items of the plant. This is of great importance, for example, in the design of new circuits which must function properly with existing telephone plant both in the transmission of speech and in the operation of signals associated with the switching equipment.

In view of the large degree of standardization of the present telephone plant, the standardization work does not consist primarily in the simplification of present practices but to a large extent in the development of new standard apparatus or materials to replace or supplement existing standards.

These new standards may have their origin in the development of new operating requirements or conditions, which are continuously reviewed by the studies of the general departments of the A. T. & T. Company in co-operation with the operating companies. An illustration of this type of origin is given by dial switching equipment for very large cities, the development of which was undertaken as the result of fundamental studies showing that the conditions in large cities are becoming progressively less favorable to manual and more favorable to dial operation.

Or the new standards may develop from an invention or a group of inventions. An example of this is a group of inventions bearing on the increase in range of telephone transmission, which opened the way to the clear transmission of speech over very long cable cir-

cuits free from interruption by storm whereas previously the voice transmission was possible through cable only over relatively short distances. This is resulting in the rapid development of a nation-wide system of toll cables to a large extent replacing for new work the previous types of toll circuits.

Again the new standards may arise from the results of fundamental research work making possible new kinds of apparatus or developing new types of materials as illustrated by the development of permalloy, a new alloy having very extraordinary magnetic properties. This new material has been applied in the design of inductance coils and of relays which can thus be made with a relatively small amount of magnetic material giving lower cost or with improved operating characteristics.

In any of these cases standardization is the final step in the process of development which is carried out by the headquarters departments, including the general departments of the American Telephone and Telegraph Company and the Bell Telephone Laboratories. The development is based upon studies of the needs of the operating companies and investigations of the possibilities of new inventions, and it results in the complete specification of the new type of apparatus or system of communication designed to best meet the end in view.

The proposed new standards are not only carefully scrutinized as to design but are given extensive laboratory tests, and most often, in addition, trials under actual service conditions before being standardized. With satisfactory results from these trials the apparatus is standardized by the A. T. & T. Co. and general information regarding it and its field of use issued to all of the Associated Companies. The new standard is thereupon adopted by each Associated Company for use to the extent that conditions in its territory present a proper field for its use.

Concurrent with the standardization of the new type

of apparatus, the Bell Telephone Laboratories provide to the Western Electric Company standard specifications covering the description and performance of the apparatus, including manufacturing tests and inspections. It is the purpose of these specifications to give adequate information to the manufacturer regarding the device and regarding the performance requirements which it must meet when completed, but not to specify in detail the process of manufacture. This is done by the manufacturing organization itself, which standardizes for each type of apparatus the methods to be followed in its production.

A great deal of attention has been given to the design of apparatus in such a way that a single piece part can be used in a large number of different apparatus units. By this means, engineering and production costs are greatly reduced through the reduction in the number of parts and the resulting large quantity production of as few standardized parts as possible.

One interesting example of this standardization of piece parts is in connection with keys, that is, hand operated switches. Keys are used in connection with telephone switchboards in large quantities and are required to perform a very wide variety of switching functions. This leads to the necessity for a large number of different types of keys. However, these keys have been so designed that certain parts are used interchangeably in many different types of keys. Because of this fact, production of such parts is very high and the keys themselves can be manufactured on an economical basis even though the demand for some particular combinations of parts may be small. A similar illustration is given in the design of relays, which are electrically operated switches.

A great deal has been accomplished in the standardization of the technical information about new apparatus standards. Drawings, for example, covering standardized equipment or apparatus are made up in



standard size and form. It has been found that 13 sizes are sufficient to meet the requirements of all but the most unusual situations.

Not only are the drawings standard in size and form, but it is found possible to use identically the same drawing in different parts of the organization, thus avoiding duplication of effort. Drawings covering the design of new apparatus made up by the Laboratories are sent to the Western Electric Company or other manufacturers involved and where applicable used by them for manufacture. These same drawings are furnished to the Associated Companies to inform them of the newly standardized apparatus and used by these companies in their technical work.

In connection with the standard drawings very large savings are made by the use of standard symbols representing pieces of telephone apparatus. These symbols are arranged in a drafting dictionary, known as the Circuit Convention Handbook, which is used by draftsmen and engineers in preparing circuit drawings. It contains conventional diagrams for all the standard types of apparatus now in use. Each of the conventions, of which there are thousands, is made up to indicate the essential functions of the piece of equipment as it affects the circuit, without showing the mechanics of the design of the apparatus involved. It also covers the abbreviations which are normally used on circuit drawings.

As an example of the effect of standardization in this particular, Figures 1 and 2 are of interest. Figure 1 is a drawing of a simple cord circuit made in 1889. Figure 2 shows how the drawing of the same circuit would be made today. The great reduction in labor of drafting and much greater ease of interpretation of the drawing are evident.

Of the above conventions those which are in general use by all telephone manufacturers are in process of

approval by the American Engineering Standards Committee as American standards, thus assuring uniformity of these conventions, not only within the Bell System but among telephone manufacturers outside the System as well.

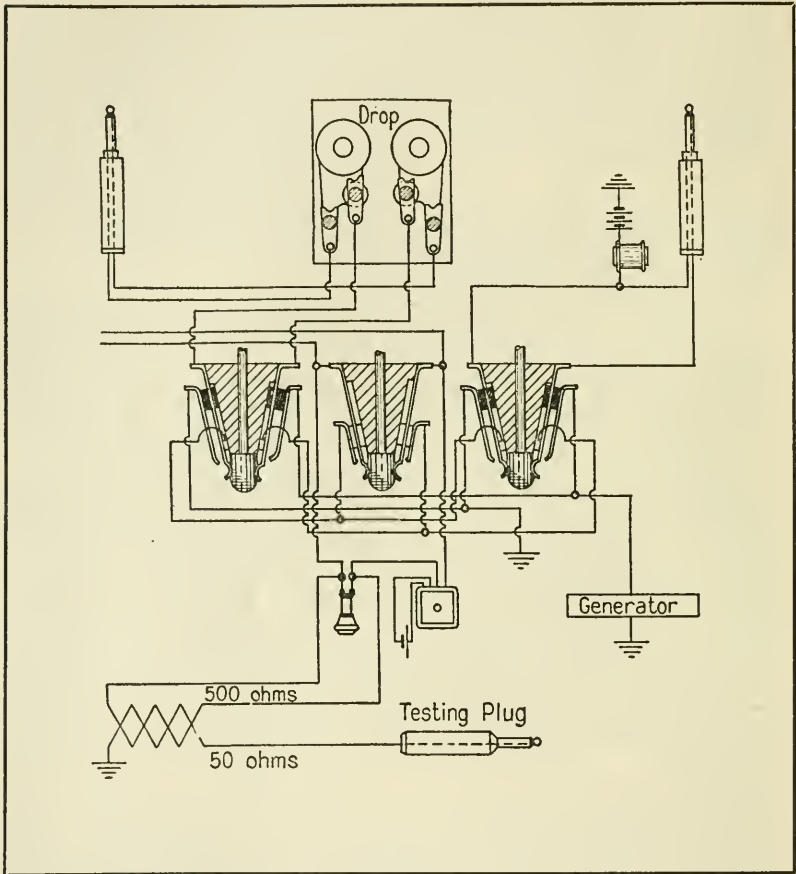


FIG. 1

The general plan outlined above for drawings is also used for the distribution of specifications for equipment design. Specifications prepared by the headquarters' forces are distributed to both the manufacturing and the operating branches of the organization. These

specifications are made uniform in style and size to facilitate their use and their filing.

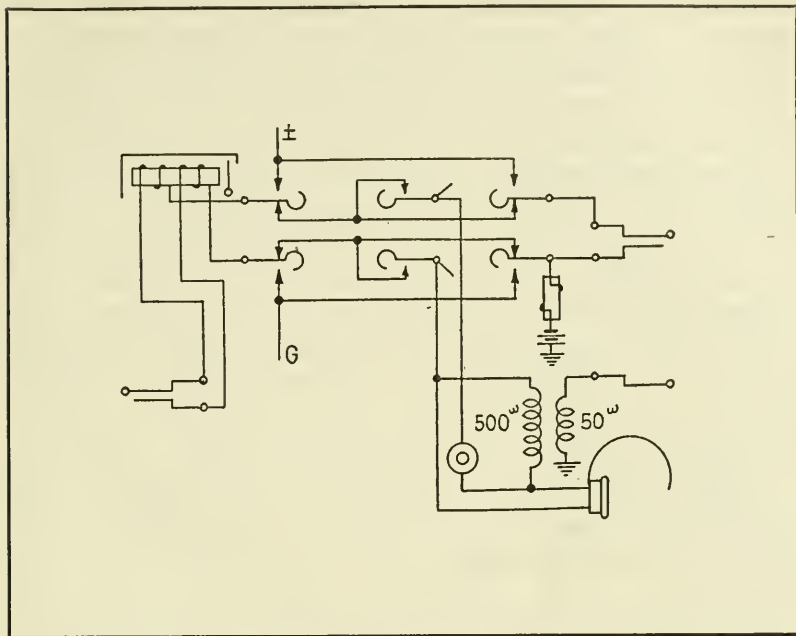


FIG. 2

### SPECIFIC EXAMPLES OF STANDARDIZATION OF TELEPHONE PLANT

It is, of course, impracticable within a limited space, to indicate all of the important items of standardization in the telephone plant. However, in addition to the illustrations used in connection with the foregoing general discussion, a few of the most outstanding results are briefly outlined below.

In local manual switchboard equipments, it is found possible to meet the widely varied demands of the Bell System with only five standard types of switchboard, three designed for common battery offices and two for magneto offices. This means that while the actual amounts of equipment required naturally vary with the size and local conditions of the office, the switchboard

in each case can be made up of assemblies of standard units corresponding to one of these five standard types.

In dial equipment the standardization is still greater. Here again there must, of course, be differences in the amount of equipment in different offices and also differences in certain items of the equipment. Beyond this, however, there are in use in the Bell System essentially only two different types of dial machine equipment. One, the panel type, is designed to meet the requirements for the larger cities, each of which has a relatively large number of offices which must be interconnected by means of the dial equipment. The other type of equipment, the step-by-step, is designed for use in the smaller cities and towns where a single office or a relatively small number of offices is adequate to provide present and prospective telephone service.

Apart from the telephone hand set which is just beginning to come into use, there are made for general use for subscribers only one type of receiver and one type of transmitter, although a small number of additional types are made for a fraction of a percent of special cases. These instruments, combined with associated ringing and auxiliary equipment, form telephone sets, some of which are desk stands and some of which are wall sets. It is found, however, that the needs of the country can be supplied with only 23 types of sets, including both those for use with dial and those for use with manual switching equipments, and including the arrangements necessitated by different types of service, as individual line, two party, four party, coin box, etc.

In the installation of telephone sets on subscribers' premises, numerous requests are received for wiring plans by which telephones may be switched from one line to another, special ringing arrangements may be provided, and extension stations may be associated with the line. The extent to which simplification in practice may be advantageous is illustrated by the results from



a single operating company of a review some time ago of their wiring plans. In this one company it was found that whereas 540 different plans were in use, the requirements could be met by 28 standard plans, and of these 28, 16 took care of all but a few exceptional cases.

In the preservative treatment of poles, while a very large number of types of treatment have been experimented with, two types have been standardized for general use. One is an overall treatment for pine poles, which require treatment for the parts exposed to the air as well for the parts in the ground. The other is a single type of butt treatment for other woods such that preservative treatment of only the part of the pole which is in the ground is adequate.

With the exception of a few special cases, the requirements of the Bell System are met by two types of standard crossarms, one designed for poles carrying only telephone circuits and the other designed for poles carrying both telephone circuits and conductors of other wire using companies.

A large percentage of the conductors in the telephone system are in cables placed in underground conduit. It is found that approximately 90 percent of the conduit is properly covered by six different types of vitrified clay, differing only in the numbers of ducts which constitute the unit.

There has been a high degree of standardization of the sizes of copper wire used for telephone conductors. 97 percent of the open wire (that is, wire strung on insulators) added to the plant at the present time is made up of three sizes, respectively, 104, 128 and 165 mils in diameter. Insulated wires in cables are also selected from a limited number of gauges. For example, long toll cables are made up practically entirely of two gauges, 16 and 19 B. & S. gauge. The cables for local distribution circuits are more than half of a single gauge, 24 B. & S., and about 95 percent are of one of three gauges, 24, 22 and 19 B. & S.

It has been possible to do a great deal in developing standards covering the best methods for the design and layout of telephone plant. A good example of this is given in the layout and arrangement of telephone apparatus in central offices. It is necessary each year to build about a hundred telephone buildings to house additional equipment. While the external appearance of the building is adapted in each case to the neighborhood in which it is placed, the dimensions and general arrangement can in most cases best be determined by using one of a limited number of standard arrangements. This makes possible the use of standard assembled equipment units, of standard detailed floor plans and equipment engineering specifications and leads to economy and speed of construction. It also insures that carefully worked out arrangements, designed to give best operating results and provide greatest flexibility for future growth, are used for all cases in which they are suitable.

Another example of this type of standardization is presented by toll circuits. If each toll circuit were designed individually to meet exactly the requirements as regards efficiency for good transmission in the particular case, the result would be that in general each small group of toll circuits between two points would differ in design from every other group of toll circuits between any other two points. This would result in tens of thousands of different kinds of toll facilities, each designed for a specific use only and would result in endless confusion and lack of practicability. Instead of following this plan, the types of toll circuit for new construction are limited to a very small number including only three types for open wire circuits and from four to six types for toll cable circuits. In the design of any given circuit choice is made from this limited number of types of facilities, selecting one which combined with suitable apparatus will give not less than the required transmission efficiency in the

given case. This results in great advantages in simplicity of plant design and in the flexibility with which facilities can be transferred from one use to another as occasion requires.

Other specific examples could be given but the above are sufficient to indicate the very important part which standardization plays in the design of telephone plant.

#### STANDARDIZATION OF RAW MATERIALS

The production of standard products naturally requires the standardization of the raw materials entering into those products. There have, therefore, been developed a series of specifications covering the standard requirements for raw materials purchased for the construction of telephone apparatus and also covering standard finishes for these materials as fabricated by the supplier.

An important example of the establishment of standards for raw material is the establishment of requirements for sheet brass of all tempers and thicknesses. This work has been extended to include nickel silvers and bronze, covering altogether seven grades of metal. Work has recently been started on rod stock. All of this work is carried on co-operatively between Bell Laboratories, the Western Electric Company and the principal suppliers of raw material.

Standard requirements for materials, of course, depend upon the establishment of suitable standard methods of test to measure the quantities which are to be specified. The American Society for Testing Materials has done a very large amount of work in developing standard tests for materials and it has been the practice to adopt these standards of test whenever they serve the purpose. As the result, a large majority of the specifications for raw material contain reference to A. S. T. M. testing methods.

In addition, however, it has been necessary to take a very considerable amount of initiative in the develop-

ment of standard testing methods. Wherever practicable this work has been done in co-operation with the A. S. T. M. and other interested organizations.

The question of hardness testing was given considerable study in connection with the work on brass and this has resulted in the adoption of standard tests for the Bell System which are now being studied by the A. S. T. M. Impact tests suitable for molded and sheet insulating materials have also been developed. Another interesting development is that of suitable tests for die castings, including tensile strength, elongation, hardness and impact strength. In developing standard methods of test for die castings, more than 55,000 specimens have been prepared to date and are being tested by the co-operating organizations.

Other standard methods of test developed through the Bell System which are of interest, are insulation resistance tests, high frequency tests and tests of insulating papers. In these tests and in others, the Bell System representatives have co-operated with the A. S. T. M. and they have adopted as standard the methods developed.

The discussion of raw materials is a natural place in which to mention the standardization of methods of sampling although this applies to completed products as well as to raw materials. In many cases it is practicable to make the tests for the check of quality on only a fraction of the material supplied. In order to insure uniform and satisfactory results, it is necessary to have standard methods of sampling including the determination of the size of the sample lots to be tested and the interpretation of the results of those tests as applying to the material as a whole.



## 1800-Pair Cable Becomes a Bell System Standard

CABLES containing 1818 pairs of No. 26 gauge wires in a sheath of standard size have recently been made available for the use of the Associated Companies of the Bell System.

This advance in the telephonic art is but one of the many benefits that the Associated Companies receive as a result of the development and research services performed for them, in accordance with the terms of the License Contract, by the American Telephone and Telegraph Company's staff of engineers and scientists, including those of the Bell Telephone Laboratories and the Western Electric Company.

In announcing the standardization of this new type of cable, it seems not amiss to indicate its relation to the prior art of cable design and manufacture as well as its setting in the whole picture of cable development that has been steadily unfolding for nearly half a century.

The progress that has been made in placing more and more pairs of wires in a cable has been described in previous articles in the "Quarterly"<sup>1</sup> and is summarized in the table below.

| Year      | Number of Pairs in Largest Cable |              |              |              |
|-----------|----------------------------------|--------------|--------------|--------------|
|           | No. 19 Gauge                     | No. 22 Gauge | No. 24 Gauge | No. 26 Gauge |
| 1892..... | 100                              |              |              |              |
| 1895..... | 152                              |              |              |              |
| 1896..... | 208                              |              |              |              |
| 1901..... | 303                              | 404          |              |              |
| 1902..... |                                  | 606          |              |              |
| 1912..... |                                  | 909          |              |              |
| 1914..... |                                  |              | 1212         |              |
| 1918..... | 455                              |              |              |              |
| 1928..... |                                  |              |              | 1818         |

<sup>1</sup> The Development of Cables used in the Bell System, April 1923, Vol. II, No. 2. Cable Development and Research, January 1924, Vol. III, No. 1.

Note: The sizes and weights of the different gauges of wire are as follows:

| Gauge<br>A. W. G. | Diameter in<br>Thousandths<br>of an Inch | Weight in<br>Pounds Per<br>Mile |
|-------------------|------------------------------------------|---------------------------------|
| 19.....           | .36                                      | 20                              |
| 22.....           | .25                                      | 10                              |
| 24.....           | .20                                      | 6½                              |
| 26.....           | .16                                      | 4                               |

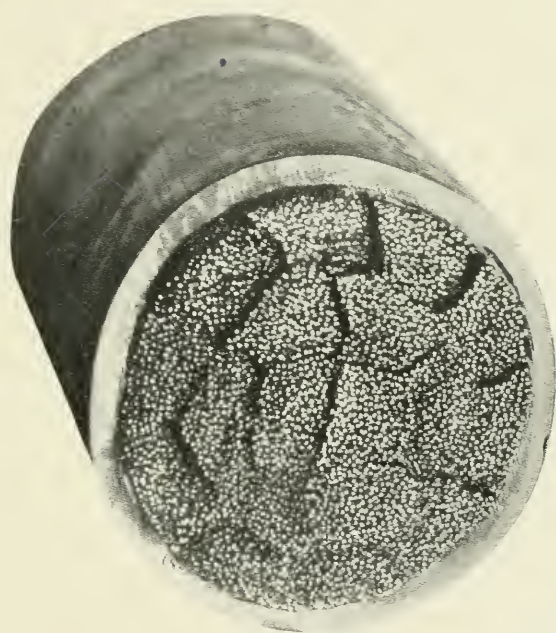
The preceding table brings out the fact that, during the period from 1914 to 1928, the greatest number of pairs that could be put into a single cable was 1200, the wires being No. 24 gauge.

In this connection the question naturally arises, why is it desirable to have as many as 1800 pairs of wires in one cable? The answer is twofold.

Chiefly in the large cities, there are places where all the ducts in the existing underground conduit systems of the telephone company are becoming occupied with cables. To provide more wires for the constantly growing telephone plant, two courses are open; either to install more underground ducts to accommodate additional cables or to replace some of the cables which now occupy ducts in the existing conduit system with cables containing more wires. In many of these situations, on account of the extent to which the space beneath the streets is occupied by rapid transit tunnels, sewers, water and gas pipes, electric light and power cables, and other subterranean works, it would be possible to provide additional telephone ducts only with great difficulty and at large cost.

Hence the relief afforded through the ability to substitute 1800-pair cable for 1200-pair cable, or smaller, either in new work or in the existing plant, is a matter of importance.

Furthermore, since every underground cable occupies a duct and must have a metallic sheath, the expense of a pair of underground wires becomes less in proportion as the cost of duct and sheath is divided among a larger number of pairs of wires in the cable. So where the use of 1800-pair cable, rather than 1200-







pair, is practicable, from a transmission standpoint, this will assist in keeping the cost of the telephone plant from mounting as rapidly as would otherwise be the case.

1800-pair cable will also affect plant engineering practices, by changing the economic relation between the costs of material and of labor. For example, where growth is rapid, there will be cases in which greater economy and better service will result from providing relief by means of new 1800-pair cable than by making a greater use of existing facilities through rearrangements and changes.

Lest it might be assumed that the development of 1800-pair cable consisted merely in substituting 26-gauge wire for the 24-gauge wire used in 1200-pair cable, it seems worth while to point out that the development required the invention of a wholly new method of forming the cable core. The type of assemblage previously used, consisted of layers of twisted pairs, laid up in the form of a helix, adjacent layers being stranded in opposite directions. This type of assemblage did not prove suitable for making 1818-pair cable and it became necessary to devise a core which virtually consists of an assemblage of 18 component cables or "units," each containing 101 pairs. These constituent cables are grouped together as shown in Figure, and this peculiar type of core construction has been given the name "multiple unit." The multiple unit core structure will undoubtedly find application in other types of cable. Each wire in this 1800-pair cable is insulated by means of a wrapping of paper tape. As in the 1200-pair cable, the paper tape is about one-quarter of an inch wide, but in the 1800-pair cable, the thickness has been reduced considerably.

Long before the telephone business reached its teens, in fact, when it was but about five years old, such cables as there were in those days—and they rarely exceeded a few hundred feet in length—made use of small

wires, sometimes as fine as No. 26-gauge. About 100 of these wires was the greatest number that was ever placed in one cable at that time. The individual wires, each insulated with a serving of cotton, were twisted into a core and boiled in paraffin. After that, the core was drawn into a lead pipe slightly larger than itself and melted paraffin charged with carbonic acid gas was forced into the pipe and allowed to cool, forming a cake of paraffin between the core and the sheath.

With the local battery system of transmission then employed, the efficiency of the cable circuits was controlled by two factors of substantially equal importance,—resistance and capacitance, or, as it was then termed, “electro-static capacity.” For a long time no means were available for materially decreasing the electro-static capacity. Therefore, as the need arose for cables of greater and greater length, the requirements for better transmission efficiency thereby brought about could be met only by using wires of larger size in order to obtain lower resistance. Gradually the size of wire used in cables was increased until No. 18 came to be common practice. Further important gains in the transmission efficiency of cable circuits became possible as soon as the use of dry paper as the insulating material was discovered to be a practical means for reducing electro-static capacity.

After loading became available for interoffice trunk cables, and as more efficient transmitters, receivers and other apparatus were developed and used, the need for such highly efficient circuits as had previously been required for subscribers’ cables became less. Consistent with obtaining satisfactory grades of transmission, it was found to be most economical to place smaller wires, and more of them, in the cables used for subscribers’ lines, compensating for their lower efficiency by the use of larger wires in the longer trunk lines and of loading to increase further the transmission efficiency of the latter. The result of designing the entire cable

plant so that all its parts will be in economic cost balance has been to increase the use of No. 22 gauge wires and, later, No. 24 gauge wires for the shorter subscribers' lines and interoffice trunks. This has been further facilitated since it has become practicable to apply loading to No. 22 gauge circuits in trunk lines. Thus have changing conditions led us in a cycle from small wires in cables, to larger ones and back again.

The extent to which cables with small wires have been coming into use is shown by the fact that while of all the exchange cable shipped to the Associated Companies by the Western Electric Company during the five-year period, 1915 to 1920, about 80 percent of the conductor mileage was of No. 22 gauge; about 12 percent No. 19 gauge; and about 8 percent No. 24 gauge (the latter consisting chiefly of 1200-pair cable); during the five-year period, 1923 to 1927, the percentages of conductor mileage of the different gauges shipped were: No. 22 gauge, 33 percent; No. 19 gauge, 11 percent; and No. 24 gauge, 56 percent.

Generally speaking, transmission considerations will limit the field of usefulness of cables with No. 26 gauge wires to subscribers' lines of moderate length and to trunk circuits used exclusively for handling traffic between offices situated near each other. As the greatest congestion of underground wires is usually found where the above conditions prevail, the 1800-pair cable will be a useful instrumentality in the service of the Associated Companies of the Bell System. Its extensive use is now being taken into account in the fundamental plans for the future.

F. L. RHODES.

## Counterless Business Offices

**T**HE rather recent development of the counterless type of business office presents an interesting feature of the efforts of the Bell System toward dealing with customers on a more individual, personal and friendly basis. In view of the fact that the business offices are the first point of contact with new subscribers, and that they handle, in the aggregate, a very large number of personal transactions with customers, it is clear that they are important factors in accomplishing this purpose; and, in addition, they are sometimes the only part of the company's premises which customers visit in person.

The usual arrangement of a business office has been to provide a portion of the space for all employees' desks and other office equipment, and to have a counter separating this from the space for customers' use. Transactions with customers are conducted across the counter, which is attended by those employees assigned to the duty of meeting customers and taking care of their requests. 'Tellers' cages, where payments of bills are received, are commonly located at one end of the counter, or adjacent to it.

Under the counterless plan the counter is done away with and each business office representative is provided with a desk, at the side of which are placed one or more comfortable chairs in which customers may be seated during interviews. Figure 1 gives a view of one counterless office, illustrating this arrangement.

In practically all of the larger counterless offices, and in many of the smaller ones, the space used by the employees engaged in handling telephone contacts and in clerical and other work is partitioned off from the remainder of the business office. This separation not only removes from the public office the unavoidable







noise and bustle incidental to the work of the large number of employees who do not handle personal contacts with customers, but it also avoids the situation occasionally arising, when all the counter attendants are engaged, where customers waiting for attention fail to understand why other employees who are in view do not wait upon them. It also makes practicable the installation in the public office of somewhat more attractive furniture and fixtures, and the decoration of this space in a more pleasing manner.

With this arrangement it is the general custom to have someone near the entrance to greet incoming customers and see that they are properly directed and that their affairs are given prompt attention. In many offices there is a floor director definitely assigned to this duty, while in other offices any one of the representatives not occupied with a customer may assume this function. The floor director may be able to handle personally some of the contacts, such as those involving only questions which can be answered quickly and simply and without recourse to records, thus saving the customer's time and expediting the work. If all the business office representatives are engaged and a customer cannot be served immediately, he is directed to space where comfortable chairs or other seating arrangements and a table with reading material are provided, and the floor director sees that he is made comfortable until a representative is free. Figure 2 presents a photograph illustrative of such an arrangement of waiting space in a counterless office.

The payment section has also been given consideration, and in many offices an open type of counter has been installed in place of the usual barred or grilled "cages." An example of this type of counter is shown in Figure 3. The payment section is usually located near the entrance for the convenience of the many customers who visit the office merely to pay their bills.

The open type counter seems to aid in making these contacts more friendly and personal.

In comparison with the counter arrangement, the counterless plan permits customers to transact their business on a more personal basis, and in an atmosphere of comparative privacy. Customers also appreciate the courtesies indicative of considerate attention which can be more gracefully extended in the counterless office, such as the fact that the representative rises to meet a customer approaching his desk, and at the conclusion of a contact also rises with the customer.

The first counterless offices were established about two years ago and experience with them has been so satisfactory that over sixty such offices are now in operation throughout the Bell System, and plans have been made for the conversion to, or establishment of, over forty additional offices under this plan during 1929. While many of the present counterless offices are small or of medium size, with from two to ten business office representatives, the plan has been introduced in some of the larger offices and experience seems to have demonstrated that it is adaptable with equally satisfactory results to these places. At the present time this plan has been decided upon for one of the largest business offices in the System, which will require from twenty-five to thirty representatives.

It is anticipated that as additional business offices are established and as rearrangements of existing offices become necessary or desirable, the counterless arrangement will represent an increasingly important aid in establishing and maintaining satisfactory relations with customers.

R. S. RANKIN.

*Editor's Note:* Mr. Rankin is of the Staff of the Commercial Engineer of the American Telephone and Telegraph Company.



## An Economic Review and Outlook

THE year 1928 was a notable one in the economic annals of the United States. This was not merely because the year witnessed various new high records of industrial output, for after all that is a normal occurrence in this country. Nor was it because of such changes as occurred in business technique or in the general economic aspect of things. The year was notable principally for its exceptional financial developments, which will be discussed forthwith.

### MONEY AND STOCK MARKETS

In an article similar to this in the January, 1928, issue of this Quarterly, the statement was made that "it would be easy to compile quite a list of contrasts between the years 1926 and 1927." Not only could the same thing be said of 1927 and 1928 but, far more strikingly than in 1927, the financial conditions and developments of 1928 grew out of, and the contrasts arose from, the conditions in the preceding year. Most clearly was this so in the case of the money and security markets, gold movements, and international financial developments.

During practically the whole of the second half of 1927, this country and the rest of the world had been treated to an exceptionally interesting exhibition of the potency of an active federal reserve policy in affecting domestic money rates. Federal reserve authorities had determined to facilitate a substantial outward movement of gold and at the same time prevent the movement from tightening the money market until such time as they saw fit to permit it to tighten. So successfully were the reins slackened that the stock market got the bit between its teeth and not only refused to be checked until the final month of 1928, but galloped

ahead with almost steadily increasing speed as the year wore on. The losses of gold were felt in the money market as soon as they ceased to be neutralized by open market operations by the reserve banks. Sales of reserve bank assets tightened money still further and were followed by three successive increases in the discount rates of most of the reserve banks. Meanwhile, through the printed word, federal reserve authorities were making clear their disapproval of the change in the credit situation and in the character of bank portfolios which the great increase in loans on securities, financing the rampant bull market, had brought about.

During practically all of 1928 the federal reserve authorities were engaged in prosecuting a tight money policy, taking cognizance at once of the stock market, of gold movements, and of that section of the Federal Reserve Act which directs the reserve banks to fix their rates of discount "with a view of accommodating commerce and business"; eight of the reserve banks having raised their discount rate to 5 percent, the highest figure since 1921, in a year in which domestic business, after recovering from the recession of 1927, showed not the slightest sign of commodity price inflation or of unhealthy boom conditions. One short-term money rate after another climbed during the course of the year to the highest figure it had reached since 1921, and still the stock market rose higher and higher. Meanwhile business during the second half of the year, when the highest money rates were prevailing, moved along at very satisfactory levels, contrasting notably with the recession that occurred in the second half of 1927, in the face of declining money. The high rates of 1928 in time naturally reacted on foreign exchanges and not only helped to check the outward movement of gold, but were instrumental in bringing about gold imports.

During most of 1928, with a satisfactory level of general business achieved, the economic indices which received the greatest amount of attention were not

statistics of steel ingot production, or of foreign trade, or of railroad freight car loadings, or all of these together, but rather any good index of industrial stock prices, and the weekly figure of brokers' loans—loans made by or through reporting member banks of New York City to brokers and dealers in securities—reported weekly by the Federal Reserve Board. Furthermore, it was not merely a natural psychological phenomenon that the interest in each of these grew as they mounted together; for in their rise were being witnessed the entrance and growth of new elements to be reckoned with in future economic analyses. In the first place, the American people during 1928 capitalized the future growth in earning power of American industrial corporations at a higher rate, particularly in relation to current money rates, than they had at least for several decades, if not for any time in the past. In the second place, many American corporations themselves assisted in this process by furnishing to the stock market an increasing proportion of the funds which the public might borrow, to buy securities for investment or speculation. It was these corporate funds, added to moneys furnished by foreign banks and investment trusts which, coming to the stock market in response to high money rates, gave it plenty of "working capital," almost regardless of the wishes of the federal reserve authorities.

After the crash of 1920–21, American industrial corporations had learned two lessons, among others, that are pertinent here. In the first place, they learned to rely as much as possible on hand-to-mouth buying of commodities, so as not to pile up unwieldy inventories or tie up cash unnecessarily. On the other hand, they decided not to rely on a hand-to-mouth policy of securing credit, but to finance themselves to a far greater extent than before the war with bond issues, or other capital obligations, relying less than previously on bank credit. The net result of these two practices and of

steadily increasing efficiency in the use of working capital, and also of a succession of prosperous years, was to put many of our large industrial organizations in possession of substantial volumes of "cash" in the form of bank deposits. The high money rates of 1928 pulled a large amount of these deposits out of the banks to be put at the disposal of the stock market, which to that extent was freed from the necessity of going direct to the banks to try to borrow money which the latter, borrowing rather heavily at the federal reserve banks, might be indisposed to lend. Brokers' loans rose from \$3,718,000,000 on December 28, 1927, to \$5,395,000,000 on December 5, 1928, much the greatest increase they had ever shown in the course of a year; and \$1,279,000,000 of the increase was in the form of loans "for account of others," that is to say, loans placed through the New York banks almost entirely by corporations, foreign lenders, and investment trusts.

#### MONEY RATES AND THE BOND MARKET

Space does not permit the tracing through of the direct and collateral effects on the banking and credit structure of the large increases in loans on securities, both by banks and by others, which accompanied the great bull market of 1928. It must suffice to say that on top of the tightening of commercial money rates, brought about by the loss to our monetary stock between the end of April, 1927, and the end of June, 1928, of \$500,000,000 of gold and by sales of federal reserve earning assets, on balance, during that period, came a much greater stiffening of Stock Exchange money rates. The spread between rates on commercial money and Stock Exchange time money became the widest since the panic of 1907, and call money on various occasions rose to 10 percent, and early in December to 12 percent. Commercial paper rates, rising for the best names to  $5\frac{1}{2}$  percent, and 90-day bankers' acceptances at  $4\frac{1}{2}$  percent or slightly above, in the second half of the year,



were at their highest levels in nearly seven years. During most of the time the stock market apparently paid little attention to the cost of money, especially since the high rates were coaxing increasing volumes of funds to the market, and supply rather than price was the more important consideration.

The bond market, however, was naturally more sensitive than the stock market both to rising interest rates and to the check imposed by the changed credit situation on increasing security investments by banks, especially during the second half of the year. A sharp decline in bond prices set in during the summer which ceased only when the volume of new bond financing, which had risen to very large totals, had been sufficiently curtailed. The curtailment took place in three directions. In the first place, certain projected domestic financing operations were unquestionably postponed or abandoned. Secondly, a substantial increase took place in the proportion of corporate financing in the form of stock issues. Thirdly, there was a sharp and sudden decline in the volume of security issues for the account of foreign borrowers. (In August, no loans at all were floated in the market for the account of foreign governmental units.) Of these three, the first was probably of least importance. The second change noted did not of course mean a curtailment in the demand for capital; but to the extent that the rising stock market and other factors had caused increasing preference by investors for stocks over bonds, the change in type of financing accommodated itself to the change in clientele.

#### SOME INTERNATIONAL DEVELOPMENTS

The curtailment in foreign financing in the second half of 1928 was one of the outstanding phenomena of the year, especially taken in connection with other items going into our international balance of payments, and in connection with some of its European effects.

In the first eleven months of 1927 our net export balance of commodities was \$605,000,000, and foreigners also took, net, \$78,000,000 of gold. The borrowed, net, \$1,307,000,000 in the form of security issues floated here. The net credit on these items in favor of foreigners was thus \$624,000,000. During the first eleven months of 1928, we not only had a larger commodity export balance, aggregating \$906,000,000, but in addition lost to foreigners about \$280,000,000 of gold, making a total of net commodity and gold exports of \$1,186,000,000. This was covered to the extent of only \$1,140,000,000 by net foreign borrowings through security offerings here, making a debit balance against foreigners of \$46,000,000, as against the credit item of \$624,000,000 a year previous. Furthermore, foreigners doubtless owed and paid us more on interest account this year than last and put substantial amounts of funds at the disposal of our stock market. It is clear that the funds lodged with our banks at the disposal of foreigners must have considerably diminished during the year and that short-term credit to foreigners in part took the place of long-term borrowings.

Here are the totals, in millions of dollars, of the net amount of foreign borrowing (governmental or corporate) in this country in the first six months and the next five months of 1927 and 1928:

|                          | 1927  | 1928  |
|--------------------------|-------|-------|
| First six months.....    | 715   | 839   |
| Next five months.....    | 592   | 301   |
|                          | <hr/> | <hr/> |
| First eleven months..... | 1307  | 1140  |

The falling off in the second half-year of 1928, in comparison both with the first half of 1928 and with the latter part of 1927, is striking.

It so happened that the decline in our foreign loans, and particularly in our loans to Germany, in the late summer, practically coincided with the beginning of a new Dawes-Plan year in which the maximum German reparation payments under the Plan would come due.

Since, in the preceding four years, the transfer of reparation payments under the Plan had been made possible to no small extent by American loans to Germany, this coincidence might have had important results if England and, to a greater extent, France had not forthwith fully substituted for the United States as a provider of funds to Germany. Here was another interesting contrast with 1927. It had been just a year previous that the federal reserve was facilitating gold exports to England and to France by means of an easy money policy in this country. This fall, with high money rates obtaining here, the two European nations, fortified by adequate banking reserves, were taking our place in transferring working capital to Germany, at such a rate that the latter country could not only meet reparation payments and pay for continued large net import balances of commodities, but also acquire in London substantial quantities of gold to be added to the reserves of the Reichsbank. Funds were attracted to Germany, of course, by high money rates, reflecting continued shortage of working capital in a country which is making every effort not only to repair wartime and post-war damages to her industrial organization, but to expand substantially her industrial plant and her exporting ability. Incidentally, by no means the least important event of the year was the initiation, on the part of the nations concerned with German reparation payments, of steps to determine along what lines the Dawes Plan should be revised.

Two important events which had been prepared for by the substantial outflow of gold from this country in 1927 and 1928 deserve mention at this point. One was the stabilization of the French franc. In June, 1928, the French Parliament passed a law which fixed the gold content of the franc at a figure which made its value about 3.92 cents, just about one-fifth of the value of the pre-war gold franc. As in the case of the other principal European countries which have stabilized

their currency, it is not intended that for the time being at least gold shall circulate as currency in France. The other event was the passage by the British Parliament in July of an act amalgamating the government currency note issue with the Bank of England note issue. The actual taking over by the Bank of liability for the currency notes, as the first step toward amalgamation, took place in November.

#### CORPORATE FINANCE; INVESTMENT TRUSTS

To return for a moment to the subject of domestic finance. In spite of some large monthly totals registered during the first part of the year, the aggregate of domestic corporate financing in 1928 was about 8 or 10 percent below the aggregate for 1927. Thanks in part to a further intensification of the merger and consolidation movement in American industry during 1928, the volume of offerings for cash by industrial corporations was little different from that of 1927. Security issues by public utilities and railroads, however, were both in distinctly lower amounts in 1928 than in 1927. The high money rates of the second half of 1928 naturally put a check on refunding financing, which had been such a striking feature of the preceding two years, and also affected possible merger financing and issues to pay for new construction. As has already been indicated, the concomitance of high money rates and a rapidly rising stock market was responsible for a definite decline in the second half of the year in the proportion of financing represented by bond issues and a roughly corresponding increase in the proportion represented by stock issues. In this connection it is interesting to note that, toward the end of the year especially, a number of offerings of "American shares" in foreign enterprises were floated. Finally, mention must be made of an extraordinary growth during the year of investment trusts and of the offering of their securities, which became an increasing factor in the se-



curity markets. The profitableness of the operations of the investment trusts organized during the past few years in a period of rapidly rising security prices, made it possible for investment trust securities to the amounts of hundreds of millions of dollars to be successfully floated in 1928. The organizations were of the most varied types as to financial structure, fields of possible investments, and powers of their managements. Their influence was felt in the stock market not only through purchases and sales of securities but through the contributions which their idle funds made to brokers' loans for the "account of others."

#### INDUSTRY; TRADE; PRICES; LABOR

This review has devoted an unusually large amount of space to the financial developments of the year, both because of their exceptional inherent interest and the striking contrasts which they afford with the developments of 1927, and because they have perhaps an unusual bearing on the prospects for 1929. Let us turn now to a consideration of some of the outstanding events of 1928 in industry and trade.

As was noted in the article a year ago, 1927 was a year of declining profit margins for many industries and was characterized by a distinct business recession in the latter part of the year which brought about considerable unemployment. On all three of these counts, 1928 furnished marked contrasts with its predecessor. Early in the year business began to recover, and later employment and profits to increase, so that on the whole 1928 was for business in general a much more satisfactory and profitable year than 1927. Because business held up especially well in the second half of the year, the comparison with 1927 grew increasingly favorable as the year wore on. The three major textile industries, to be sure, found it hard sledding during the greater part of the year for most of their branches. Overcapacity and under-employment still persisted in

the coal industry, both before and after the abrogation during the year of the Jacksonville wage scale in those mines and districts where it was still actually or nominally in force when the year opened. The newsprint paper industry felt increasingly the effects of Canadian competition. Only rather radical measures of restriction of production enabled the oil industry to present a more favorable picture at the close of the year than at the beginning. Railroad equipment manufacturers still suffered from a continuance of the policy of meager purchases of locomotives and freight cars by the country's transportation systems. Certain of the food and allied industries felt the effects of competition and/or surplus production, domestic or foreign. Automobile tires were produced in record volume, but profits of tire manufacturers were severely cut into by sharp declines in the price of their principal raw material.

As against these and other relatively unfavorable developments that might be mentioned were such favorable factors as the letting of a new high record total of building contracts (to which increased residential, industrial, and public utility and public works projects all contributed), something like record output of automobiles, highly active operations in the agricultural implement and machine tool industries, a large volume of business by electrical equipment manufacturers, and, of course, underlying all these, an active iron and steel industry, making a new high record output of steel. Once the recovery from the recession in 1927 had been achieved, furthermore, industrial activity ran along on an even keel with little fluctuation, on the average, other than of seasonal character. As employment gradually increased, conditions in trade improved and the volume of retail trade in the last quarter of the year, culminating in Christmas buying, was doubtless of record proportions.

Prices of industrial commodities have on the average been firm and relatively stable. With certain

marked exceptions, such as rubber, with its sharp price decline, and copper, which enjoyed a notable rise in price, and hides, which moved widely in both directions, there has been little evidence at any time in the price structure of tendencies toward serious weakness or toward inflation or runaway markets. The stability of domestic business at a high level and the maintenance of reasonably satisfactory economic conditions abroad have contributed to price stability, while the absence not only of shortages of materials but of any factors like transportation difficulties, major labor troubles, and credit stringency, has prevented price inflation.

In the field of labor, the most important event doubtless was the abandonment of the Jacksonville wage scale and the substitution of district for nation-wide wage agreements in the bituminous coal industry. As has already been said, there were no major labor troubles in 1928. Both wage increases and wage cuts have occurred in various industries, but, on the whole, the average level of wages has remained practically unchanged. The year saw continued progress made in the field of industrial relations. It saw only a partial solution of what the article a year ago called a major problem of 1927, that of unemployment; though by the end of the year there were reports of shortages of certain types of skilled labor.

Indications are that agricultural income for the crop year 1928-29 will be little different from that of the preceding year. Live stock prices have been at good average levels during the year, benefiting stock raisers. Grain and other crops have been generally bountiful, though in many cases prices are low. Whatever the record sales of agricultural implements have indicated as to improved farmers' income, they at any rate point to a continuing desire on the part of farmers to operate with increasing efficiency.

The dollar figures of net exports of commodities in our international trade have already been cited. The

increase this year over 1927 has been due both to lower import values and to higher export values. The former are accounted for principally by lower prices of rubber, silk and sugar, rather than by decreased physical volume; to the latter, a substantial growth in exports of finished manufactures, especially automobiles, machinery, and petroleum products, has been the principal contributor. Changes in the sources or destinations of our imports and exports have been relatively slight and of little significance for the economic picture as a whole.

No review of 1928 would be complete which did not take cognizance of the merger and consolidation movement, to which casual reference was made in the discussion on finance. Perhaps no other year in our history has been more notable in this field. Horizontal and "circular" rather than vertical combinations predominated. Economies of distribution quite as much as, if not more than, economies of production were stressed by the promoters of many of the mergers. This is not the place to discuss the ramifications of the merger movement. Suffice it to say that, what with mergers, investment trusts, the ever widening operations of trade associations and institutes, and the growing size of some of our units of distribution, exemplified by the chain stores and mail order houses, American business in 1928 moved noticeably in the direction of increasing concentration of control of business processes. Incidentally, very definite possibilities are involved therein for an increasing degree of stabilization, through greater business efficiency in every phase of operations. Labor, as such, consumers, investors, and business generally should benefit from intelligent use by management of the opportunities afforded by the evolution that is going on.

#### THE OUTLOOK FOR 1929

The year 1928 ended with industry and trade active and generally prosperous. High money rates in 1928



did not prevent business expansion, and expanded output and keen competition did not prevent larger profits from being made than were made in 1927. The recession in 1927 helped, to be sure, to pave the way for greater output in 1928, partly because the recession was to a considerable extent linked with special conditions in the automobile industry which made for sharp recovery in that industry in 1928. Doubtless, too, the stock market of 1928 was not without its stimulating effect on business. The notable and unexpectedly large volume of construction activity, in the face of rising money, however, had no specially favoring causes; it apparently represented principally a continuance of the forces that have sustained the "building boom" for a full half decade. Generally increasing business efficiency clearly played a part in the satisfactory results of 1928. So did improvement in the agricultural situation, in the broadest sense of that term. The exceptional prosperity of our northern neighbor, Canada, undoubtedly was felt on our side of the border. Perhaps these were the principal contributing factors to the good business of 1928. Will they or other factors make themselves felt in 1929 and sustain business at or above present levels? Or will they be overcome by unfavorable forces?

Present indications are that business in 1929 will have to take for granted moderately high money rates, on the average. Only large gold imports and/or a severe and prolonged reaction in stock prices could be counted on to ease money rates; apart from a change in federal reserve policy. None of these three now seems to be in the cards. Money rates, however, do not promise to bring about any serious slowing up of business. Prospects are for a very active first quarter of the year and that period may hold the key to results for the rest of the year. If production of automobiles is pushed too hard and allied and ancillary industries speeded up too much, a situation not dissimilar to that

of 1924 may result, though the reaction may be much less severe. If manufacturers generally and those responsible for construction activity hold operations within bounds during the first quarter or first half of 1929, any subsequent slowing up should be of moderate extent. There is no promise of 1929 being a boom year as a whole. The year 1928 has apparently accomplished most of the climb up from the minor recession of 1927.

Most of the stimuli that operated in 1928 are likely to be less potent in 1929 in sustaining business. Our large output of automobiles and of buildings, our extended credit structure on a reduced gold base, our distended stock market, the restriction on foreign borrowing here, imposed by our high money rates,—all these and other factors seem to point to no such gain in 1929 over 1928 as the latter achieved over the second half of 1927. Yet there is nothing to indicate that a marked business recession is in the making. We can take for granted steadily increasing business efficiency, an international economic situation which is relatively favorable, no possibility of credit stringency for business, generally satisfactory labor conditions, and an agricultural situation which, if anything, is slowly on the mend. In the framework of these, we may look for a business year in 1929 which will on the average just about measure up to the record of 1928 in volume of activity, and perhaps also in profits.

F. E. RICHTER.

## The Key Town Plan of Selling by Telephone

**K** EY town selling, a plan for using the telephone in the sales process, is one of the answers to the present-day demand that distribution be simplified; it is an expression of the effort, by fully employing the tools of modern business, to keep step in distribution with the advances which have brought to America world leadership in production. As competition brought about a struggle for the national market, production processes were challenged, analyzed, improved. Greater production with lowered costs resulted; but it was a production which called for more consumers and so for the further development of markets.

The substitution of machines for muscle; the use of men's brains rather than their brawn; the saving of time and making saved time productive; these have characterized the reduction of manufacturing to a science. There, too, the telephone has played an increasingly important part. A large saving is made by a railroad shop when well placed telephones put a stop to "walking to talk." The lifting of a receiver is a substitute for many ten minute trips. Similarly an oil refinery secures economies by making dial telephone service available in its plant twenty-four hours a day, seven days a week, so that well paid employees are able to remain on their jobs and give them close supervision.

But with production still improving its methods, there has come to the attention of American business the fact that distribution has not kept the pace. The demand from those charged with selling, that more of an article be supplied at a less cost, caused those in production to study and change their methods in their search for improvement and economy. But with the lowered costs of producing, the percentage that distri-

bution represents in the final cost of almost any article, whether a product of the farm or factory, has steadily increased until it has been authoritatively stated that the greatest problem before American business today is the reduction of these distribution costs.

Much has been done and many have contributed. The railroads have effected economies by reducing the time that goods are in transit, and by increasing the number of ton miles per car. Methods of reaching the consumer have undergone experiment, if not change. The development of house-to-house selling, not one, in the last analysis, to produce greater economy but principally to further consumption, is one manifestation. The chain store is another, with its purpose of reducing overhead costs by better organization methods and of eliminating credit losses by cash transactions. In other retail stores changes have come about, with the dual purpose of securing greater sales and a lowered percentage of overhead. Hardware and drug stores have followed a policy of placing merchandise where it is accessible to customers, eliminating, to a large extent, show cases which form barriers between customers and the goods they want.

Many of these latter activities have dealt with the form of presentation of the merchandise to the ultimate consumer. The element in the process of distribution, however, which has come in for the greatest discussion has been the middleman. Emphasis is given by the fact that no effective substitute has been found for the jobber and the wholesaler, and apparently none is in prospect. A retail store, for example, selling items produced by hundreds of different manufacturers, cannot very well purchase all those items from that number of individual manufacturers. Neither can those manufacturers, who must sell their product to exist, arrange to do business directly with such a large number of retail stores. Today the trend is towards reducing rather than increasing the number of accounts, at least



as far as the retention of small, profitless accounts is concerned. Even the chain stores, which may manufacture many of their own products, find it necessary to provide for the jobbing or middleman's function. They establish warehouses and distribution plants which are neither more nor less than their own provision for the middleman's services.

And yet, necessary as it is to face the responsibility of meeting, in distribution, the advances that have been made in production, it can be safely said that there have been but few economy-producing changes in methods and practices made in the last twenty-five years. To many of those which have been made the telephone has contributed. For example, the use of the telephone typewriter in expediting the handling of orders when they are received at an office, particularly when the offices and the warehouse are separated by some distance, has resulted in large economies. Such internal improvements, however, are not enough. The main problem which confronts the middleman, whether he be jobber, or wholesaler, or manufacturer performing for his own organization the function of the middleman by selling directly to retailers, is that of reducing his selling cost so that the process of getting the retailer to place on his shelves the merchandise he really wants, and must have to satisfy the demands of his public, is less expensive. There has been what might be termed a vicious circle of selling. Increased production, one of the accompanying factors of lowered cost, has resulted in an increased pressure to sell. The increased pressure to sell has resulted in an increase in the number of contacts with present and prospective customers which, in turn, results in greater sales to be followed by more production, to be followed by a demand for greater sales, then more contacts, more sales, and so on. The four points of the sales compass are, then:

1. More production
2. Demand for more sales

3. More contacts

4. Increased sales

One of the basic principles of selling is that to sell, salesmen must be in personal contact with customers. Obviously, to sell more they must see more customers or see customers more often, or both. The result is a piling up of sales expense, more traveling, more men, more supervision, which, as business becomes harder to get, reduces the margin of profit. This, in addition, has been affected by the development of hand-to-mouth buying. During the post-war depression, when manufacturers, wholesalers, and retailers, all found themselves with large inventories on which they were forced to take, in many instances, a heavy depreciation, there developed as a fundamental the principle that stocks on hand should not exceed foreseeable requirements. This is particularly true of retailers, who developed the habit of buying in very small quantities. Some carried this to excess, buying, for example, one sixth dozen where a dozen or even a gross would be a proper purchase for the period represented by any reasonable turnover objective.

This adoption of hand-to-mouth buying has meant that to secure orders, the sellers to a retailer must have contacts with the retailer at the beginning of each of the greatly shortened buying periods, particularly if the goods sold happen to be of a competitive nature where another manufacturer or another line might be substituted. Some means, therefore, is sought by manufacturers and wholesalers to secure the contacts which are needed without the expense which the old system, a system which has gone practically unchanged for years, represents. One of these attempts, and a very good one, was to maintain contact with customers by mail during the intervals between visits. However, it was learned by many, at their own cost, that it is rarely the case that a letter will be successful in competition with a salesman present in person, just as future

deliveries always are at a disadvantage against spot merchandise. It was found that the use of direct mail matter was at its best as an aid to salesmen, just as advertising in periodicals was found to be a helpful support, and reduced the amount of work that the salesmen had to do—decreased the amount of sales resistance.

Supplementing this, other methods were tried to save the time of the salesman and increase his effectiveness. Telephone calls were placed, first from within the same city and later, as the practice extended, from other cities, telling the approximate time of a salesman's visit so that a greater proportion of his day would be spent in doing the work for which he was paid, selling in the presence of the customer.

It was not long before it was discovered that more business than the making of appointments could be handled by long distance telephone service. Just what was the first instance which showed what could be done can only be surmised. It may be that a salesman, delayed by missing a train, finally beat his competitor to some business by placing a long distance call, an occurrence of which there have been many instances. It may be that a salesman, confined to his home or the hospital by an accident, anxious to keep his hold on his territory, turned to long distance service to maintain his business contacts; and there have been many instances of this also. It is also possible that when called for an appointment or about some other matter, the customer gave his order over the telephone, saving a trip for the salesman and suggesting an idea of which he was quick to take advantage. In any case, those who, for one reason or another, had tried selling by long distance turned to it again and again until, in many lines of business, it became a standard policy.

These pioneers developed two systems of selling by telephone. One, known as the skip-stop system, involved calling at every other town in a large territory

on one trip, for example, during the first two weeks of the month, and the other towns on the next trip; but each time calling by telephone from the most convenient points the towns which were being skipped.

Others developed the practice of calling all of the cities in one trade territory from the principal city of that territory, and then moving to the next trade center and calling its tributary cities. Generally some provision was made, even under this central calling system, for periodic visits in person, visits which could be made somewhat longer and more personal than the hurried calls when the visits were more frequent.

Sales managers discovered that star salesmen were being developed who covered larger territories and did more business, yet whose costs in relation to sales were extremely low. The cost of calling all the cities in one trade territory might be less than the cost of the railroad fare to one of the least important ones.

In this, many of those who are studying the problem of more economical distribution believe they have discovered one means of meeting the seemingly impossible joint demand for more business and, therefore, more frequent contacts, with lowered selling costs. As sales executive after sales executive became aware of the possibility, there was developed, based on the experience of those who were actually doing the selling, a systematic plan for handling business in this manner, called the Key Town Telephone Sales Plan. This Key Town Telephone Sales Plan was neither more nor less than the co-ordinating of the principles already discovered in such a way as to get the greatest possible return from this versatile tool of business, the telephone.

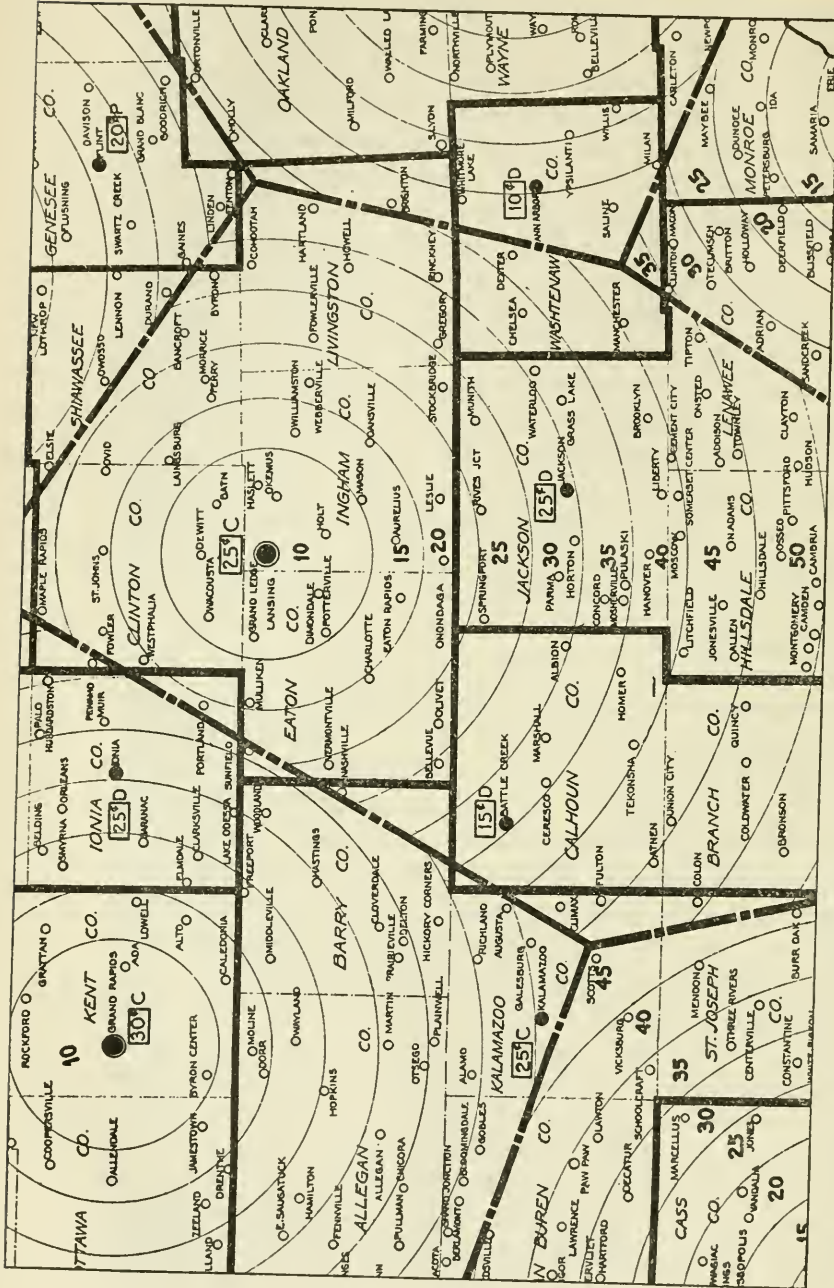
The Bell telephone companies proceeded to map out their territories, selecting key towns or primary calling points, each associated with its appropriate trade territory. These key towns were selected for a variety of reasons which included their relation to normal trade



territories, their central location, railroad facilities, hotel accommodations, etc. There entered also the question of telephone facilities, toll centers, if smaller cities were under consideration, receiving the preference on account of the faster telephone service to be secured. The primary areas were then broken down into secondary areas. These secondary areas were chosen on the same general considerations as primary areas. The secondary areas were necessary for some classes of trade. For example, a firm of wholesale grocers would intensely cover smaller areas, doing business with most of the retail grocers in each area, while the manufacturer or jobber engaged in some other line might find his market in relatively few cities. The former would do their calling from the secondary key towns to their closely placed customers in the secondary calling areas; the latter from the primary key towns to more widely separated customers in the larger, primary calling areas.

For most businesses using the key town plan a certain number of personal visits would be made, interspersed between the telephone calls. Other businesses, particularly those which are re-selling for the jobber or wholesaler, such as is done by some match companies, might use long distance calls exclusively, making no personal visits at all. This is also true of a large publishing company, the magazine of which has a high subscription rate. The continuations of subscriptions to this magazine are usually secured by means of a toll call from a primary calling point. Visits in person would be out of the question, whereas in a day or two a large number of long distance calls can be talked on, and this unusual method of approach produces a very satisfactory number of continuations.

All of the Bell operating companies have prepared key town sales maps of the states in their territories, available for the use of sales executives. In addition, there is available a Key Town Telephone Sales Map



LAYOUT OF KEY TOWN TELEPHONE SALES AREAS.

SHOWING PRIMARY AND SECONDARY CALLING POINTS AND ASSOCIATED CALLING AREAS.

◎ Primary Calling Point. ● Secondary Calling Point. — Primary Calling Point Area. — Secondary Calling Point Area.

Customers Facilities

C—Customers Room.

P—Use of Private Office.

D—Use of Desk Space.

of the United States showing all primary calling area boundaries, and all primary and secondary calling points, as well as a large proportion of the cities having one thousand or more population. The key town designations and area lines have been shown in red to make the map easier to use in plotting sales territories. These maps are one of the aids furnished to facilitate the use of the key town plan, and, therefore, to further the use of toll service, making its use easier and more convenient for customers.

The illustration of a section of the Michigan key town map on the preceding page shows how primary and secondary calling areas are arranged. The figures shown in the zones are the station-to-station day rates to points in the circle from the respective primary calling points or key towns. The boxed figure at each secondary calling point shows the average cost of calling every business telephone subscriber in the area.

Other conveniences also contribute to the plan. The first of the two most important is the use of sequence toll call lists. The use of sequence lists is, of course, not limited to those who are using the key town plan as they are of value to anyone having several calls to make from a particular point within a limited period of time. If, for example, a sales manager knows that he is going to call his thirty branch offices, he can receive the most convenient service if he will prepare a list of those offices with their addresses and, if possible, their telephone numbers, and send it to the chief operator somewhat in advance of the time he wishes to talk. If it is his practice to call these branch offices every week or every two weeks the same list can be used indefinitely and the time of both the sales manager and the telephone company conserved.

The purposes of such lists are varied, but perhaps the majority of the sequence toll call lists which are filed are for the purpose of calling customers to maintain contacts and make sales. Oil companies, for ex-



ample, file them to expedite giving price changes; produce companies make a practice of using such lists to inform their customers of current market offerings; financial houses with long lists of widely scattered customers who buy frequently use sequence lists to call

|                                                                                                                                               |                           |                                                                 |                                                                                                                       |                                |                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| (See Reverse Side for Suggestions as to the Use of this Form)<br><b>SEQUENCE TOLL CALL LIST</b>                                               |                           |                                                                 |                                                                                                                       |                                | Form E-405                                                                                                                 |
| DELIVER TO _____ (NAME) _____                                                                                                                 |                           |                                                                 | SHEET NUMBER _____                                                                                                    |                                |                                                                                                                            |
| (TELEPHONE COMPANY) _____                                                                                                                     |                           |                                                                 | CODE LIST NUMBER OR LETTER _____                                                                                      |                                |                                                                                                                            |
| (STREET) _____                                                                                                                                |                           |                                                                 | (CITY) _____ (STATE) _____                                                                                            |                                |                                                                                                                            |
| CALLING COMPANY OR PARTY _____                                                                                                                |                           |                                                                 | TEL. NO. _____                                                                                                        |                                |                                                                                                                            |
| PERSONS WHO WILL TALK _____                                                                                                                   |                           |                                                                 | WHEN SERVICE DESIRED* _____<br><div style="text-align: right;">A. M.<br/>P. M.</div>                                  |                                |                                                                                                                            |
| <div style="display: flex; justify-content: space-between;"><span>1.</span><span>2.</span><span>3.</span><span>4.</span><span>5.</span></div> |                           |                                                                 |                                                                                                                       |                                |                                                                                                                            |
| 1                                                                                                                                             | CALLED PLACE<br>AND STATE | CALLED TELEPHONE<br>NUMBER.<br>IF NOT KNOWN<br>FILL IN COLUMN 5 | WHEN STATION-TO-STATION<br>SERVICE IS WANTED INDICATE BY (SS), OTHERWISE, SHOW PERSON DESIRED, WITH ALTERNATE, IF ANY | ** DIS-<br>POSITION<br>OF CALL | FIRM NAME OR NAME AND INITIALS OF<br>PERSON UNDER WHOSE NAME THE<br>TELEPHONE IS LISTED<br>TOGETHER WITH ADDRESS, IF KNOWN |
| 2                                                                                                                                             |                           |                                                                 |                                                                                                                       |                                |                                                                                                                            |
| 3                                                                                                                                             |                           |                                                                 |                                                                                                                       |                                |                                                                                                                            |
| 4                                                                                                                                             |                           |                                                                 |                                                                                                                       |                                |                                                                                                                            |

these customers' attention to favorable offerings. These sequence lists are also used by those employing the key town plan, who welcome them as a means of making this sales method more convenient and rapid.

Their use is necessary in connection with the second important aid for those using the key town plan. This is the Bell System Credit Plan. It provides a way for responsible concerns to arrange for credit for their traveling representatives, thereby eliminating the necessity of carrying funds for the payment of charges on toll calls. At the same time it gives a better control and check at the company's home office of the sales activities.

For example, if a company should desire to adopt the key town plan, it would first designate the article or articles to be sold and the personnel to be assigned to selling. Lists of customers would then be compiled to be called from the selected key towns. Because intensive coverage at a minimum of expense is possible with the key town plan, reference may well be had to



the classified business telephone directories as a valuable source of information as to all the prospects in any line of business. The customers called from a particular key town would be those within the designated calling area of that city, as these areas are selected with a view to reducing the cost of calling the business sub-



**BELL SYSTEM**  
IDENTIFICATION CARD

1928 No.

THIS WILL IDENTIFY  
REPRESENTATIVE OF THE

WHICH HAS ARRANGED THAT CREDIT BE EXTENDED TO SAID REPRESENTATIVE ON CHARGES  
FOR SERVICE RENDERED OVER BELL SYSTEM LINES UNTIL DECEMBER 31<sup>ST</sup> 1928  
AS SHOWN BY AND SUBJECT TO THE CONDITIONS ON THE BACK HEREOF

VALID WHEN COUNTERSIGNED BY

COUNTERSIGNATURE

scribers, or any selected group of such subscribers, within the area. Arrangements would be made at the same time with the Bell Associated Company in whose exchange the concern is located for the issuance of Bell System identification cards under the credit plan. These cards would be issued to all of the salesmen and, equipped with them, the salesmen could then file and talk on their calls at any Bell office, having the bills sent to the home office of their company.

At many exchanges, and the number is gradually increasing, the Bell telephone companies are providing special facilities for those selling by telephone. Customers' rooms are being installed, equipped with telephones and desks so that the salesmen can talk on their calls with privacy and comfort.

It is not too early to know that the use of the key

town telephone sales plan has already begun to occupy an important place in the business life of America. National advertising and co-ordinated, aggressive sales activities have resulted in a marked stimulation of interest in key town selling. It is only reasonable that in a country which has the largest percentage of the world's telephones, far-sighted business men should take advantage of the opportunity these telephones afford to do a greater volume of business at a less expense; a function that is appropriate to the telephone, which has always been the means of saving the time of the individual, yet increasing his effectiveness, through the ability to transport his ideas and his personality instantaneously over intervening miles.

RICHARD WHITCOMB.

*Editor's Note:* Mr. Whitecomb is of the staff of The Commercial Engineer of The American Telephone and Telegraph Company.

## Notes on Recent Occurrences

### PRESIDENTS' CONFERENCE

A CONFERENCE of Presidents of Bell System companies took place at Yama Farms, New York, from October 2 to 8.

### PLANT OPERATION CONFERENCE

THE Plant Operation Conference held at Pinehurst, North Carolina, from October 22 to 31, was the first System conference devoted entirely to plant activities. Previous conferences have been held jointly with the Engineering Departments, but the growth of the supervisory personnel and the increasing importance and diversity of the subjects to be discussed have made separate conferences desirable. The total attendance was approximately 110, the Associated Companies and the Long Lines Department being represented by their thirty-two General Plant Managers, with about the same number of Division Plant Superintendents and several Vice Presidents and General Managers.

Prior to the conference, a number of regional committees, each composed of from three to five General Plant Managers, undertook the study of some of the more important phases of plant operations, including plant engineering, construction, installation, maintenance, plant employee training, plant staffs, and various plant phases of service to the subscriber. The committee's reports were presented at the conference by the respective chairmen, following introductions by members of the General Staff. Matters pertaining to supplies, motor vehicles, plant employee representation and plant employment conditions, together with the matter of sale of service, were presented by the General Staff. The presentations were followed in each case by prepared discussions given by those Plant Managers

who had indicated in advance their desire to discuss the particular subject covered by the report. This was followed, in turn, by an open discussion on the floor.

Throughout the conference, particular emphasis was placed on giving a plant service which would be increasingly satisfactory to the telephone using public. The discussion related largely to ways and means of making further improvement along such lines as reducing service interruptions, reducing the out-of-service time when interruptions do occur, extending the hours during which repair service is available, more closely meeting the customer's desires with respect to the time of installing and moving his telephone and insuring a prompt, courteous and intelligent treatment of subscribers in all of their contacts with plant employees. Emphasis was given also to the desirability of a more intensive application of accident prevention measures, improvement in appearance of plant, sale of service by plant employees, and the advance programming of plant work, and particularly improved training of all the plant forces.

An exhibit room was set up in which were shown a number of the more recent developments in equipment, methods and practices.

At an evening session, demonstrations were given of the effects of power arc follow-up during lightning storms and a stereopticon illustration of the effect of circuit defects on transmission.

During the conference, the General Plant Managers were asked to designate the particular activities which they considered the most important ones on which to focus plant effort during the next two years. In their replies, the following ten items were mentioned most frequently.

1. Training of plant employees.
2. Accident prevention.
3. Increased speed of installing and moving telephones.



4. Improving the grade of outside plant maintenance.
5. Sale of service by plant employees.
6. Improving the grade of substation and P.B.X. switchboard maintenance.
7. Improving transmission.
8. Personalizing the service and improving customer contacts.
9. Clearing subscribers' troubles more promptly.
10. Reducing troubles affecting subscribers' lines.

Talks on matters of particular interest were given by Mr. Page, Mr. Hall, Mr. Gherardi, Mr. Waterson, Mr. Charlesworth, Mr. Wilson, Mr. Allen and Mr. Burcher, chairman of the conference.

The conference covered thoroughly all the more important phases of plant operations and the committee representing the Associated Companies expressed the opinion, which was also that of the General Staff, that the conference had been especially effective.

## TRANSMISSION CONFERENCE

THE transmission engineers of the Bell System met in conference at 195 Broadway, New York City, from November 14 to 22, to discuss ways and means for further improving telephone transmission, and securing greater continuity of service of the plant. The conference was attended by about 50 representatives of the Associated Companies, the Long Lines Department of the American Company, and the Bell Telephone Company of Canada and also by various officials and members of the Headquarters staff in New York.

The conference was opened by H. S. Osborne, Transmission Engineer of the A. T. & T. Company, who also presided throughout the sessions. The various scheduled subjects were briefly presented and discussed in short papers prepared by both Associated Company and A. T. & T. Company representatives, after which considerable time was devoted to general discussions and

questions on each subject. A general outline of a program of improvement in toll transmission was discussed, followed by more detailed discussions of toll transmission surveys, toll cable problems, switched toll connections, carrier problems, modernizing low quality plant, etc. The program for further improving local transmission was covered, including specific discussions of local plant design and special subscribers' services. This was followed by the general subject of transmission maintenance, including transmission service observations, reports of poor transmission, station and loop maintenance and toll transmission maintenance. Connecting company and rural line transmission problems were considered very fully. The discussions on inductive co-ordination covered particularly the trend of power companies' practice, the prevention of noise in local telephone plant from both external and internal sources and low frequency induction. Other subjects discussed included foreign wire relations, protection and telephone service to power companies. Transmission training work was also very fully discussed by the conferees. One session was devoted to a presentation of transmission development matters by O. B. Blackwell, Transmission Development Engineer and members of his staff, and by H. S. Warren, Electrical Interference Engineer.

President Walter S. Gifford addressed the conference, pointing out that in spite of the tremendous strides which the telephone business has made there are still a large number of important problems before the telephone organization in the further improvement of service and indicating the great responsibility of those concerned with transmission work in the further progress for which the telephone organization is working. He emphasized particularly the further improvement of transmission on short and moderate haul toll business and the problems involved in providing improved service to rural communities as two of the outstanding

activities to which it is important that increased attention be directed at the present time.

During the conference there were also addresses by Vice Presidents Bancroft Gherardi, F. B. Jewett, and A. W. Page of the A. T. and T. Company on general Bell System matters. T. G. Miller, General Manager of the Long Lines Department, outlined the problems of that department. C. G. Stoll, Vice President of the Western Electric Company, Inc., addressed the conferees on Western Electric Company, Inc., matters pointing out the need for a close co-operation between the Operating Companies and the Western Electric Company, Inc., in regard to scheduling telephone supplies and equipment. Operating matters from both the traffic and plant standpoints were reviewed by K. W. Waterson, A. J. Allen, M. B. French, and D. C. Hosfeld, and commercial matters by L. B. Wilson. H. P. Charlesworth reviewed the plant engineering activities, including the five-year program, rural lines and connecting company problems, improvements in the appearance in the telephone plant and other matters in which the transmission engineers are directly concerned.

The sessions of the conference were supplemented by inspection trips to the Bell Telephone Laboratories and the Western Electric works at Kearny, and by exhibitions of demonstration apparatus for showing transmission losses and power arc follow-ups, and by a number of other exhibits.

## GENERAL STATISTICAL CONFERENCE

A GENERAL Statistical Conference of the Bell System was held in New York City from December 3 to 8, attended by those in charge of statistical work in the Accounting Departments of the Associated Companies and by certain staff representatives of the American Telephone and Telegraph Company.

The purpose of the Conference was primarily to afford an opportunity for the discussion and review of the progress which has taken place during the three and a half year period since the preceding Conference in the development of statistical analysis and presentation of accounting and other data as administrative aids. In the light of the experience of the Companies to date, there was general discussion of the most profitable lines of future development of such statistical work and careful consideration was given to the general character of these statistical activities which will make them most valuable. An important subject considered by the Conference related to the types of statistical work best adapted to meeting the needs of area operating organizations.

Emphasis was placed upon the importance of selecting significant facts, of designing statistical work to meet individual needs, and of adjusting current work in accordance with changing requirements, in order that the statistical work of the Accounting Departments may at all times be of greatest service to the business as a whole.

During its proceedings, the Conference was addressed by President Gifford, Comptroller Heiss, and Assistant Comptroller Behan.

## FURTHER EXTENSIONS OF TRANSATLANTIC TELEPHONE SERVICE

### DANZIG

ON October 15 transatlantic telephone service was extended to the Free City of Danzig in Europe. Danzig has a population of 400,000 in an area about 27 miles square. The municipal government operates the telephone system comprising 17,200 telephones. Connection with America is effected through a submarine telephone cable under the Baltic Sea connecting Danzig with Germany.



## ONTARIO AND QUEBEC

Facilities of the transatlantic telephone service, which had previously been opened only to certain specified Canadian cities, were made available on October 15 to all points in the provinces of Ontario and Quebec.

## SPAIN

Telephone service between North America and Madrid was inaugurated by conversations between President Coolidge and King Alfonso XIII on October 13. The ceremonies at Washington took place in the directors' room of the United States Chamber of Commerce. President Walter S. Gifford of the American Telephone and Telegraph Company acted as master of ceremonies at Washington, while Colonel Sosthenes Behn, President of the International Telephone and Telegraph Corporation, acted in a similar capacity in Madrid.

Addressing King Alfonso, President Coolidge said: "I welcome this added link, no less strong because it is invisible, between Spain and the United States. I believe it to be true that when two men can talk together the danger of any serious disagreement is immeasurably lessened and that what is true of individuals is true of nations. The international telephone, therefore, which carries the warmth and the friendliness of the human voice, will always correct what might be misinterpreted in the written word.

"Whatever brings our two countries closer is of value to us and to the world. This western hemisphere, discovered by the wonderful navigators of Spain, has always owed much to your country. The language of Spain is the language of a great part of the Americas. The fine traditions of Spain are the basis of the culture of a large part of the Americas and our friendship with the great nations to the south draws us closer to their mother country. With your country and with

theirs the United States stands for the promotion of world understanding and peace. I was therefore particularly pleased that Spain so promptly and generously adhered to the general pact for the renunciation of war. It was what I expected on the part of your great and peace loving nation.

"I am especially glad thus orally to greet your Majesty because I know the position of great personal responsibility you hold in directing the policies and progress of your country. I wish for Your Majesty a long and happy life and for your country all the prosperity and happiness which come from wise and benevolent leadership in all those things which make life richer and finer."

King Alfonso, speaking in English, replied:

"I heartily reciprocate in my own name, and in that of Spain, the greetings of Your Excellency.

"Mr. President: I thank you for the cordial words in which you do Spain the honor and justice to recognize her outstanding services to the Americas, and I agree that we ought to expect from this new means of communication ever closer relations because of the intimate and more perfect understanding between the two peoples.

"I reiterate to Your Excellency with my salutations, the testimony of my most sincere appreciation, and extend best wishes for the peace and prosperity of the United States."

J. Reuben Clark, Assistant Secretary of State, spoke in behalf of the State Department at Washington. His greeting was acknowledged by Ambassador Ogden H. Hammond, speaking from Madrid, as follows:

"It is a great honor to be the first American Ambassador to Spain to communicate with the Department of State by means of this wonderful invention of wireless telephony, which brings Spain and the United States so close together.

“The point has often been made that easy and rapid communication prevents misunderstanding. To my mind they may do much more, they not only augment existing friendships but create new ones and this telephone service inaugurated today, on the eve of the meeting of all of the Americas at the Sevilla Exposition, forges another and valuable link in our chain of friendships.”

Greetings were also exchanged between President Walter S. Gifford and the Marques de Urquijo, President of the National Telephone Company of Spain. Mr. Gifford said:

“Although I have been in the telephone business all my life, I confess it gives me a thrill to talk over the lines of four countries, through the air over the ocean, under the sea by cable, over the Pyrenees, and to get from you in a fifth of a second a message from the country whence Columbus started upon his momentous journey, based on the belief that the world was round. Faith in science led to the discovery of this continent and as his spiritual successors we firmly believe that science is and will continue to develop it to the increasing comfort, effectiveness and happiness of man. And it is a pleasure for us to work in co-operation with those engaged elsewhere in advancing the telephone art. My colleagues and I extend to you our congratulations for the success of the National Telephone Company of Spain.”

The Marques de Urquijo replied:

“Thanks to the co-operation of the French Post Office, through whose territory we pass, and the co-operation and facilities of the British General Post Office with its Rugby Radio Service, it has been possible for his Majesty the King to greet the President of the United States and inaugurate the telephone service between Spain and the United States. It is also my privilege to greet you, Mr. Gifford, as President of the great American Telephone and Telegraph Company,

which company has been a constant inspiration in the development of our Spanish Telephone Company over which I have the honor to preside. May I extend to you and your colleagues my most cordial salutations."

A month later, on November 14, King Alfonso again participated in the opening of telephone service to an American country when he exchanged felicitations with General Gerardo Machado, President of Cuba. Speaking from Madrid, King Alfonso said:

"Mr. President: It gives me great satisfaction to be able to communicate by telephone with the chief of the Cuban nation. Your country, inspired by your Excellency's heartfelt sentiments, has been giving constant proofs of its devotion to Spain which both my country and I reciprocate with genuine sincerity."

General Machado replied in part:

"Your Majesty: I am experiencing at this moment one of the greatest emotions of my life, because I am able to communicate with Your Majesty and to express to you the profound happiness which I feel in speaking with the august head of the nation which discovered and colonized our hemisphere."

The Cuban President was then greeted by General Primo de Rivera, President of the Council of Ministers of Spain, and the Cuban Secretary of State, Dr. Rafael Martínez Ortiz, replied. An exchange of greetings between Dr. Ortiz and the Cuban Ambassador at Madrid, Honorable Dr. Mario García Kohli, followed; and General Primo de Rivera then spoke with Sr. Alvaro de Baldonado, Chargé d'Affaires of the Spanish Embassy in Havana. The ceremonies were concluded with an exchange of greetings between officials of the National Telephone Company of Spain and the Cuban Telephone Company.

On November 26 the telephone service connecting North America and Madrid was extended to embrace the whole of Spain, which has approximately 141,500 telephones serving a population estimated at 22,450,000.



MEXICO—EUROPE

Transatlantic telephone service, which was already in effect between Europe and a number of important cities in Mexico, was extended on November 1 to the city of Puebla, Mexico.

AUSTRIA

On November 3 Vienna, the capital of Austria, eleventh largest city in the world, was connected with the transatlantic telephone circuit. Vienna has a population of nearly 2,000,000 and is served by 110,000 telephones.

The service was opened with conversations between Chancellor Dr. Seipel of Austria and Secretary of State Kellogg in Washington, and between other American and Austrian officials. Dr. Seipel said:

“I have it at heart to express my sincere joy that modern technical science has succeeded in bringing our countries nearer by means of this further facility of international communication.”

Mr. Kellogg replied in part:

“With this new means of communication we shall have closer relations than ever.”

HUNGARY

Budapest, the capital of Hungary, was brought within the scope of the transatlantic telephone service on November 12. Service was formally opened with the transmission of greetings from President Coolidge, transmitted by Secretary of State Kellogg who, speaking from Washington, said to Count Bethlen, Premier of Hungary, in Budapest:

“The President has asked me to extend through you to the Regent and people of Hungary, on behalf of himself and the people of the United States, cordial good wishes for the continued prosperity and happiness of the Hungarian people.

"The opening of this service will bring to your countrymen and my fellow-citizens of the United States the realization that our peoples are being brought closer together every day by the progress of science in thus establishing direct telephonic communication between the two countries, and it is with a feeling of great pleasure that the people of the United States of America inaugurate direct communication with your people to-day. I wish to tell you also how sincerely happy I am to hear your voice and to feel that we have thus established a new bond in the relations between our two countries."

Conversations also took place between J. Reuben Clark, Assistant Secretary of State, and J. Butler Wright, American Minister at Budapest; and between John Pelényi, Hungarian Chargé d'Affaires at Washington, and Count Bethlen.

Hungary was the fifteenth European nation to be brought within speaking distance of America. Budapest has about 50,000 telephones serving nearly a million people.

#### CZECHOSLOVAKIA

On November 24 Prague, the capital of Czechoslovakia, was added to the European points accessible over the transatlantic telephone circuit. Prague has a population of about 725,000 with 34,000 telephones. The service to Prague was opened with an exchange of felicitations between Secretary of State Kellogg and Dr. Edouard Benes, Foreign Minister of Czechoslovakia, who also spoke with Ferdinand Veverka, the Minister of Czechoslovakia at Washington. In his conversation with Dr. Benes, Secretary Kellogg said:

"It gives me a great pleasure to greet you in the name of the government and people of the United States upon the occasion of the inauguration of the telephone service between our two countries.

"It is most impressive to me to think of our voices bridging the space and distance between us at one

bound and I cannot but feel that the result of the linking together of our two countries by this new means of communication will be the further increasing of the friendly ties of sympathy and understanding which have existed between our two peoples since the establishment of your state."

In the course of his reply Dr. Benes said:

"Direct telephonic communication brings our nation still closer to the North American nation, whom we esteem so highly for their momentous share in our struggle for liberty and whose sons made such sacrifices in the common fight and who play the role of pioneer in the daily economic and cultural life of the world."

#### SPANISH MOROCCO, AFRICA

Transatlantic telephone service between North America and Europe reached a point in still another continent—Africa—on November 26 when connection was established with Ceuta, Spanish Morocco, Africa, which is linked to the telephone system of Spain by submarine cable across the Strait of Gibraltar.

#### FRANCE

Transatlantic telephone service, which has included Paris since March 28, 1928, was extended on December 15 to embrace about one hundred points in France covering practically the entire country and including 532,800 telephones. With this extension of service the total of American and European telephones which may be interconnected by means of the transatlantic circuit is brought to approximately 26,750,000.

#### COMSTOCK PRIZE TO C. J. DAVISSON

The National Academy of Sciences has awarded the Comstock Prize to Clinton J. Davisson, of the Bell Telephone Laboratories staff of scientists. This prize is given each five years for "the most important discovery

or investigation in electricity or magnetism or radiant energy"; this year it amounts to \$2,300. It was granted "for experimental work demonstrating that under certain conditions electrons behave as trains of waves might be expected to behave."

Presentation of the award was made at the Autumn Meeting held at Schenectady, November twentieth, by Dr. Thomas Hunt Morgan, President of the Academy.

#### DR. FRANK B. JEWETT AWARDED EDISON MEDAL

THE seventeenth Edison gold medal has been awarded by the American Institute of Electrical Engineers to Dr. Frank B. Jewett, Vice President of the American Telephone and Telegraph Company, in charge of the Department of Development and Research, and also President of the Bell Telephone Laboratories, New York City, "for his contributions to the art of electrical communication."

The Edison gold medal "for Meritorious Achievement in Electrical Science, or Electrical Engineering, or the Electrical Arts," was founded in 1904 by the friends and associates of Thomas A. Edison in commemoration of the first quarter century in the art of electric lighting. The medal was "to serve as an honorable incentive to scientists, engineers and artisans, to maintain by their works a high standard of accomplishment." It was designed by James Earl Frazer and bears on its obverse a portrait of Mr. Edison and on its reverse an allegorical conception of "the genius of electricity crowned by fame."

It is interesting to note that Dr. Jewett began his work in the Bell System the year of the establishment of the Edison medal. After graduate study at Chicago University and two years of teaching at Massachusetts Institute of Technology, he entered upon his life work of telephone engineering. As Transmission Engineer he did notable pioneer work in the development of the



theory and practice of voice transmission over wires. As Chief Engineer of the Western Electric Company and later as Lieutenant-Colonel of the U. S. Signal Corps, he served with distinction on army and navy committees during the World War. The Distinguished Service Medal was awarded to him. Combining high technical skill and unusual executive ability, Dr. Jewett has directed the work of a large group of scientists and engineers who seek to advance the communication art in all of its ramifications. Author of brochures, articles, and public addresses on physical and electrical subjects, Dr. Jewett occupies a prominent place in professional engineering societies and educational circles.

The formal presentation of the medal to Dr. Jewett will occur on the evening of January 30 during the annual mid-winter convention of the American Institute of Electrical Engineers, held in New York.

Alexander Graham Bell, inventor of the telephone, was awarded the Edison medal in 1916, and Gen. J. J. Carty, Vice President of the American Telephone and Telegraph Company, was the recipient in 1918.

#### MR. GIFFORD IS U. S. STEEL DIRECTOR

On December 18 President Walter S. Gifford of the American Telephone and Telegraph Company was elected a Director of the United States Steel Corporation.

## Abstracts of Technical Papers from Bell System Sources

*Decibel—The Name for the Transmission Unit*,<sup>1</sup> by W. H. Martin. In this article is defined the transmission unit that was adopted by the Bell System in 1923 for expressing telephone transmission efficiencies and levels. A brief outline is given of the reasons for the adoption of the name “decibel” for this unit.

*The Principles of Electric Circuits Applied to Communication*,<sup>2</sup> by H. S. Osborne. This paper discusses the method of presenting in the curricula of engineering schools the fundamental electrical principles emphasizing the desirability of presenting them as far as practical in a general way and of making clear the relations of specific applications, such as the relation between circuit theory equations as applied to power systems and to telephone systems, and the relation between ordinary circuit theory and the generalized electromagnetic equations. An outline is given of some interesting problems arising and results obtained in the application of electric principles to telephone systems.

*Magnetic Properties of Perminvar*,<sup>3</sup> by G. W. Elmen. This paper describes the magnetic properties of a group of iron-nickel-cobalt alloys, named “perminvar.” With certain heat treatments these alloys have unusual constancy of permeability and extremely small hysteresis losses at low flux densities, and peculiarly shaped hysteresis loops constricted in the middle as

<sup>1</sup> Bell System Technical Journal, January, 1929.

<sup>2</sup> Bell System Technical Journal, January, 1929. Presented at Pittsburgh, July 18, 1928, at the Summer School for Electrical Engineering Teachers under the auspices of the Society for the Promotion of Engineering Education.

<sup>3</sup> The Journal of the Franklin Institute, Vol. 206, No. 3, September, 1928; Bell System Technical Journal, January, 1929.

the maximum flux densities of the loops are increased. Methods of preparing and heat treating the alloys are described, limits of composition, and changes in the magnetic properties with composition and with different heat treatments are illustrated. A theory of constitutional changes effected by heat treatment and responsible for the unusual magnetic properties is suggested.

*The Aluminum Electrolytic Condenser,*<sup>4</sup> by H. O. Siegmund. In this paper the anodic film-forming properties of aluminum are discussed and the unique electrical qualities of film-coated aluminum anodes are described. Special reference is made to an aluminum electrolytic condenser of the type used in low pass electric wave-filters of direct current telephone power plant equipment. Electrical characteristics of condensers are given and the manner is described in which the operation and life of the units are influenced by variations in composition of the electrodes and the electrolyte.

*Contemporary Advances in Physics XVII. The Scattering of Light with Change of Frequency,*<sup>5</sup> by Karl K. Darrow. This article deals chiefly with one of the most interesting and important developments in physics during 1928, which may be described as the recognition that quanta or corpuscles of light may be reflected from molecules or atoms in such a way, that in the process they give up some of their energy to the reflecting particle, or take some energy from it. Owing to these transfers of energy the frequencies of the quanta are changed, a fact which is expressed by saying that light is scattered with change of frequency or change of wave-length. Several different cases of this effect have been discovered, the earliest-known being

<sup>4</sup> Bell System Technical Journal, January, 1929. Presented before the American Electrochemical Society at Bridgeport, Conn., April 26, 1928.

<sup>5</sup> Bell System Technical Journal, January, 1929.

the scattering of X-rays with change of frequency by free or nearly free electrons, the "Compton effect"; while the one which directed attention to the general principle, the scattering of visible light with change of frequency by organic liquids, was discovered by Raman. The principle itself corresponds closely to a similar one for electrons, and emphasizes the resemblance between electricity and light.

*Ground Return Impedance: Underground Wire with Earth Returns,*<sup>6</sup> by John R. Carson. In certain transmission problems principally those relating to induction and interference phenomena, it is necessary to know the transmission characteristics of a circuit composed of an underground wire with earth return. These can be evaluated by well known engineering formulas provided the ground return impedance is known. The present paper gives the mathematical solution of this problem and shows that the ground return impedance is substantially independent of the depth of the wire below the surface.

*Application to the Binomial Summation of a Laplacian Method for the Evaluation of Definite Integrals,*<sup>7</sup> by E. C. Molina. The numerical evaluation of the incomplete Binomial Summation, a problem of major importance for many statistical and engineering applications of the Theory of Probability, is a question for which a satisfactory solution has not as yet been obtained. Several approximation formulas have been presented, each of which gives good results for some limited range of values of the variables involved; but a formula of wide applicability is still a desideratum.

The purpose of this paper is to submit for consideration an approximation formula which seems to meet the situation to a measurable extent.

<sup>6</sup> Bell System Technical Journal, January, 1929.

<sup>7</sup> Bell System Technical Journal, January, 1929. Presented before International Congress of Mathematicians at Bologna, Italy, in September, 1928.



*A New Method of Obtaining Transient Solutions of Electrical Networks*,<sup>8</sup> by W. P. Mason. A new method for obtaining transient solutions of electrical networks is developed in this paper which depends upon the fact that a distortionless line can be made to approach as a limit all three of the circuit elements, resistance, inductance and capacity. The process of solution consists in solving for the current in a distortionless line—which is ordinarily a simple process—and then proceeding to the limiting case of the distortionless line which approaches the element or elements of interest. Some examples are worked out and a derivation of the Laplacian integral solution is given. It is interesting to note that this method gives a formal solution of the Laplacian integral equation.

*Acoustic Considerations Involved in Steady State Loud Speaker Measurements*,<sup>9</sup> by L. G. Bostwick. Certain difficulties encountered in acoustic measurements of the performance of loud speakers are described. Because of the nature of these difficulties it has not yet been possible to specify a complete and simple set of measurements or conditions which will completely express the performance of a loud speaker. Data are given showing the performance of two representative types of loud speakers both when measured in outdoor space free from reflections and when measured under varying conditions in a specially treated acoustic laboratory. The differences serve to emphasize the importance of certain precautions in the making of indoor acoustic measurements.

*Recent Advances in Wax Recording*,<sup>10</sup> by H. A. Frederick. This paper considers chiefly the frequency-response characteristics and limitations of the

<sup>8</sup> Bell System Technical Journal, January, 1929.

<sup>9</sup> Bell System Technical Journal, January, 1929.

<sup>10</sup> Bell System Technical Journal, January, 1929. Presented before Society of Motion Picture Engineers at Lake Placid, New York, September 26, 1928.

lateral cut "wax" record. It shows that the frequency range from 30 to 8,000 cycles can be recorded and reproduced from the record with practically negligible deviation from a flat frequency-response characteristic. The paper brings out the ease with which the record can be immediately replayed from the "wax" as an aid in assisting the artist to obtain the best results. A brief description is given of commercial processing methods including both plating and pressing. These methods give essentially a perfect copy of the original "wax." The time required for this work has been considerably reduced of late so that a test pressing can be obtained within three hours of the cutting of the original "wax."

*Sound Recording with the Light Valve*,<sup>11</sup> by D. Mac Kenzie. The light valve developed by Bell Telephone Laboratories is an electromagnetic shutter consisting of a loop of duralumin tape formed into a slit at right angles to a magnetic field. Sound currents from the microphone and amplifier flow in this loop causing it to open and close in accordance with the current variations.

The slit is focussed by a lens on the sound negative film. An incandescent ribbon filament is focussed on the light valve, and the light passed by the undisturbed slit appears on the film as a line at right angles to the direction of the film travel. As the valve aperture is modulated by sound currents, the film receives a varying exposure and a sound record of the variable density type is obtained.

For talking pictures such a sound film is made on a separate recording machine synchronized with the camera and is printed alongside the picture on the finished positive. The prints are displaced so that the sound is advanced over the corresponding picture.

<sup>11</sup> Bell System Technical Journal, January, 1929. Presented before Society of Motion Picture Engineers at Lake Placid, New York, September 25, 1928.

This is in order that the sound may be projected at a point of continuous film motion below the picture gate.

*Synchronization and Speed Control of Synchronized Sound Pictures*,<sup>12</sup> by H. M. Stoller. The reproduction of the synchronized sound picture of today presents no serious problem of synchronization, for this factor has been practically eliminated by the perfection of electrical means for reproducing sound with equipment which may be coupled mechanically to the picture projector.

The important problem of the present day, in connection with the reproduction of synchronized sound pictures, is the provision of suitable means for maintaining a constant speed of the sound reproducing mechanism in order that the pitch of the sound being reproduced may not suffer any sudden change which would be sensed by a good musical ear. Control circuits using vacuum tubes with a frequency bridge as a speed standard with provision for manual variable speed control are described and explained for use with both AC and DC motors. Remote synchronization permitting the recording of pictures and sound simultaneously on equipment located some distance apart is obtained by a modification of the Michalke electric gear system.

*A Sound Projector System for Use in Motion Picture Theatres*,<sup>13</sup> by E. O. Scriven. The general problem involved in the design of a system suitable to be used to record and reproduce sounds such as are required for "talking" motion pictures is outlined. The general method of attack is indicated. There follows a description of the several pieces of apparatus which

<sup>12</sup> Bell System Technical Journal, January, 1929. Presented before Society of Motion Picture Engineers at Lake Placid, New York, September 24, 1928.

<sup>13</sup> Bell System Technical Journal, January, 1929. Presented before Society of Motion Picture Engineers at Lake Placid, New York, September, 1928.

comprise the theatre equipment, including a discussion of some of their salient features and of the part each plays in the sound projector system.

*The Communication System of the Conowingo Development*,<sup>14</sup> by W. B. Beals and E. B. Tuttle. This paper describes the communication system which has been installed to serve the power plant at Conowingo, Maryland, and its associated transmission line.

The important features to be considered in designing a telephone system for a power plant are pointed out. The types of telephone switchboard and telephone instruments chosen in this case to meet the special requirements of the generating station, together with the layout and cabling arrangement, are outlined.

The paper also discusses the possible ways of providing for the needs of the load dispatcher and the plan adopted at Conowingo; the facilities provided the patrolmen for calling from points along the transmission line; the connection from the private branch exchange to the general telephone system; and the special electrical protection installed on the long lines leaving the power house.

*Reflection and Refraction of Electrons by a Crystal of Nickel*,<sup>15</sup> by C. J. Davisson and L. H. Germer. This is a report of further observations on the regular reflection of electrons from the surface of a nickel crystal; an earlier report was published in the same journal.<sup>16</sup> In the present report data are given of the selectivity of reflection for angles of incidence from 10 to 50 degrees, and for electrons of wave-lengths 0.6 to 1.5 Å. The previously found result is confirmed that to explain the occurrence of the intensity maxima of the

<sup>14</sup> Journal of the A. I. E. E., October, 1928, pp. 737-741.

<sup>15</sup> Proceedings of the National Academy of Sciences, August, 1928, pp. 619-627.

<sup>16</sup> Proceedings of the National Academy of Sciences, April, 1928, pp. 317-322.



reflected beam it is necessary to assume that electron waves are refracted on passing into the crystal. The data are used for calculating indices of refraction for nickel for electrons of various speeds or wave-lengths, and a dispersion curve is constructed. This curve displays a feature suggestive of the optical phenomenon of anomalous dispersion.

*Optical Experiments with Electrons*,<sup>17</sup> by L. H. Germer. A semi-popular account of a series of experiments performed by C. J. Davisson and the author upon the scattering of electrons by single crystals of nickel. These experiments establish the fact that under certain conditions moving electrons behave like trains of waves. In the interaction of these waves with a single crystal the optical phenomena of diffraction, reflection and refraction have been observed. Scientific accounts of these experiments are contained in the following papers: *Nature*, 119, 558 (1927); *Phys. Rev.*, 30, 705 (1927); *Proc. Nat. Acad. Sci.*, 14, 317 (1928); *Proc. Nat. Acad. Sci.*, 14, 619 (1928). Although the present paper is of a popular nature it aims to be quite comprehensive. It attempts to represent the status of this series of experiments in August, 1928.

*Rubber Compression Testing Machine*,<sup>18</sup> by C. L. Hippensteel. This paper gives a brief account of a new compression test developed at the Bell Telephone Laboratories for more reliably judging the ability of rubber insulation on metallic conductors to withstand certain service conditions to which it is subjected. A recording compression testing machine, which has been built for applying the test, and typical results are illustrated. Other possible test uses for the machine are suggested.

<sup>17</sup> *Journal of Chemical Education*, Part I, September, 1928, pp. 1041-1055. Part II, October, 1928, pp. 1255-1271.

<sup>18</sup> *India Rubber World*, September, 1928, pp. 55-56.

*New Languages from Old—How Secrecy is Gained by the Inversion of Speech Sounds,*<sup>19</sup> by C. R. Keith. The inversion of speech sounds may be accomplished with the aid of methods used in radio broadcasting and in carrier telephony. Among the possible applications, it is illustrative of methods used to achieve secrecy in electrical communications.

The character of speech sounds is determined by the frequencies and amplitudes of the component waves into which the sound may be resolved. The process of inversion consists effectively in altering the frequency distribution of these components so that low tones appear as high tones, while high tones appear as low tones. To the untrained observer, inverted speech is unintelligible, although the characteristic cadence is preserved. Inversion of the frequency scale is produced by modulating speech with a carrier wave which lies just above the highest speech frequency which is to be transmitted, and selecting the lower sideband. For practical reasons connected with undesired distortion, it is more desirable to break up the modulating process into two distinct steps. The original speech sounds may then be regained by repeating the process which led to its inversion.

*Joint Pole Use with Power Companies,*<sup>20</sup> by D. E. Lowell. The relations between the telephone company and the other wire using companies, especially the power companies operating in the same area, are discussed in this paper. It recognizes the responsibility of the telephone company as well as that of the power company for good operating conditions in areas where both types of line are involved and also points out the necessity of close cooperation between Connecting and Bell Telephone Companies. The considerations involved in the joint use of poles by telephone and power

<sup>19</sup> Scientific American, October, 1928, pp. 310-311.

<sup>20</sup> Telephony, September 8, 1928, pp. 22-24.

companies are given with particular mention of the general joint use agreement. The importance of mutual advance notice of plans is developed. The reports of the Joint General Committee of the N. E. L. A. and Bell System form the background of the talk and are recommended to those who have not already read them.

*Adsorption of Gases by Graphitic Carbon. II—X-Ray Investigation of the Adsorbents,*<sup>21</sup> by H. H. Lowry and R. M. Bozorth. This paper is supplementary to one by Lowry and Morgan appearing in the *Journal of Physical Chemistry* in 1925<sup>22</sup> and gives direct evidence that the adsorbents studied were graphitic carbon. The X-ray data shows that carbon prepared by the explosion of graphitic acid is graphitic in structure and that the individual particles are flakes averaging approximately 50 atom diameters in breadth and 10 atom layers in thickness. The significance of this finding is discussed in relation to current views of the nature of active carbon adsorbents.

*Recent Toll Cable Construction and its Problems,*<sup>23</sup> by H. S. Percival. One of the outstanding developments in the Bell System has been the rapid extension of toll cables. This has required the development of new methods and apparatus. Material is carried into rough right of way and installed through the use of tractors, with equipped trucks and various types of automotive equipment. The development of permalloy now allows the complete loading of a full-sized cable in two pots where six were required before. Crossings over rivers are made in submarine cable or by long span construction with catenary suspension. Cables are tested before completion for sheath damage, defective splices, etc., which might cause service failures, by means of dry gas under pressure.

<sup>21</sup> *Journal of Physical Chemistry*, October, 1928, pp. 1524-1527.

<sup>22</sup> *Journal of Physical Chemistry*, Vol. 29 (1925), p. 1105.

<sup>23</sup> *Telephone Engineer*, September, 1928, pp. 31-33.

*Quality Control by Sampling*,<sup>24</sup> by W. L. Robertson. A discussion of the application of the mathematical theory of sampling to commercial shop inspection. Also gives tables illustrating numerically the results obtained from the various sampling plans in use.

*Problems in Power Line Carrier Telephony and Recent Developments to Meet Them*,<sup>25</sup> by J. D. Sarros and W. V. Wolfe. Power transmission lines as commonly encountered present relatively complex networks having irregular and unstable attenuation-frequency characteristics within the 50-150 K.C. band employed for power line carrier telephony. The high frequency noise may be very high.

A single side band carrier suppressed system operating on a single frequency duplex basis has been developed to overcome these transmission difficulties.

A comparison of this system with other types shows its superiority.

The initial installation of this equipment was made on the 220 K.V. lines of the Pacific Gas and Electric Company.

*The Planning of Telephone Exchange Plants*,<sup>26</sup> by W. B. Stephenson. This paper discusses procedures followed in planning future extensions to telephone exchange plants to care for increased demand for telephone service. An outline is given of the methods employed in forecasting future demand for telephone service and in determining the most efficient design of the plant to meet the service requirements. The uses made of engineering comparisons in solving the economic phases of various kinds of telephone engineering problems are discussed, with particular refer-

<sup>24</sup> *Factory and Industrial Management*, pp. 503-505, September, 1928; pp. 724-726, October, 1928.

<sup>25</sup> *Journal of the A. I. E. E.*, October, 1928, pp. 727-731 (abridgment).

<sup>26</sup> *Journal of the A. I. E. E.*, July, 1928, pp. 500-503 (abridgment).



ence to location and size or extent of major items of plant as well as the time when they should be ready to give service. Emphasis is placed upon the importance of those factors less readily evaluated, such as service factors, practicability from a construction and operating standpoint, flexibility, etc.

*The Effect of the Acoustics of an Auditorium on the Interpretation of Speech,*<sup>27</sup> by E. C. Wentz. Studies of speech sounds in the Bell Telephone Laboratories have shown that 60 per cent. of the acoustic energy in speech lies below 500 c.p.s., although the intelligibility of individual speech sounds is reduced by only 2 per cent. if all the energy below this frequency is completely suppressed. These results indicate that the sound absorption coefficient of materials placed in an auditorium for reducing the reverberation time should be high for tones of low frequency and low for those of high frequency. Most porous materials commonly used for this purpose have absorption characteristics quite the reverse. Rooms that have been treated with a rather large amount of such materials are therefore often unsatisfactory for speaking purposes, although the adjustment for reverberation time may have been carried out according to accepted standards.

<sup>27</sup> *The American Architect*, August 20, 1928, pp. 259-261.

## Organization Changes

### AMERICAN TELEPHONE AND TELEGRAPH COMPANY

*John H. Ray appointed General Solicitor.*

Entered employ of the Bell System as Attorney, American Telephone and Telegraph Company, New York City, February 15, 1923; General Attorney, December, 1923; General Solicitor, January 1, 1929.

### NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY

*G. K. Manson appointed Chief Engineer.*

Entered employ of the Bell System as Night Operator, New England Telephone and Telegraph Company, Exeter, N. H., 1892; Workman, repair shop, Boston, 1895; Cableman at various points in New England, 1895; Special Inspector, 1896; Switchboard Man, 1899; Electrical Engineer, 1901; Engineer, 1905; Chief Engineer of Plant, 1910; Chief Engineer, Boston, 1913; Chief Engineer, January 1, 1929.

### SOUTHERN AREA

*H. E. Darling appointed General Manager, Southern Area.*

Entered employ of the Bell System as Assistant in Traffic Engineering, American Telephone and Telegraph Company, Boston and New York City, 1906; Engineer, New York City, 1909; Acting Office Manager, Operation and Engineering Department, August, 1922; General Traffic Supervisor, New England Telephone and Telegraph Company, Boston, August, 1923; General Traffic Manager, December, 1925; General Manager, Southern Area, January 1, 1929.

*L. W. Layton appointed General Traffic Manager.*

Entered employ of the Bell System as right-of-way Agent, American Telephone and Telegraph Company, New York City, February, 1905; Manager, Washington, D. C., December, 1905; Clerk, Columbus, O., July, 1907; Manager, Indianapolis, September, 1907; District Traffic Chief, April, 1908; Service Inspector, Central Union Telephone Company, Cleveland Telephone Company, Michigan State Telephone Company and Wisconsin Telephone Company, Chicago, July, 1911; General Traffic Supervisor, January, 1912; Traffic Supervisor, August, 1912; Traffic Supervisor, Chicago Telephone Company, March, 1914; Toll Traffic Manager, October, 1915; Division Traffic Supervisor, May, 1916; Assistant Traffic Superintendent, July, 1918; Traffic Superintendent, Cleveland Telephone Company, Cleveland, October, 1919; Division Traffic Superintendent, Ohio Bell Telephone Company, January, 1921; Division Traffic Superintendent, New England Telephone and Telegraph Company, Boston, July 31, 1923; General Traffic Manager, Southern Area, January 1, 1929.

*R. C. Marden appointed General Plant Manager.*

Entered employ of the Bell System as Relief Operator, New England Telephone and Telegraph Company, Claremont, N. H., 1894; Night Operator and Combination Man, 1895; Lineman, 1895; Canvasser and miscellaneous work, Northern Division, 1897; Chief Clerk, Burlington, Vt., 1897; Lowell, Mass., 1900; District Superintendent, Fitchburg, Mass., 1906; District Plant Chief, Manchester, N. H., August, 1908; Division Superintendent of Plant, June, 1917; Springfield, Mass., December, 1922; General Plant Supervisor, Boston, March, 1926; General Plant Manager, Southern Area, January 1, 1929.

*C. B. Allsopp appointed General Commercial Manager.*

Entered employ of the Bell System as Clerk, Pacific Telephone and Telegraph Company, San Francisco, April, 1909; Traffic Inspector, Oakland, August, 1909; San Francisco, May, 1910; District Traffic Chief, Napa, July, 1910; Fresno, October, 1911; Traffic Chief, July, 1912; resigned December, 1912; reengaged as Division Traffic Agent, San Francisco, April, 1913; District Traffic Chief, March, 1918; Acting Division Superintendent of Traffic, August, 1918; Traffic Engineer, October, 1919; Acting Division Superintendent of Traffic, Portland, Ore., December, 1919; Division Superintendent of Traffic, May, 1920; Division Superintendent of Traffic, New England Telephone and Telegraph Company, Providence, R. I., August, 1923; Division Commercial Superintendent, December, 1925; Division Manager, February, 1926, Boston, May, 1927; General Commercial Manager, Southern Area, January 1, 1929.

*B. J. Bowen appointed Engineer.*

Entered employ of the Bell System as Service Inspector, New England Telephone and Telegraph Company, Boston, 1902; Division Traffic Engineer, 1903; Equipment Engineer, 1905; Traffic Engineer, August, 1908; Assistant General Superintendent of Traffic, September, 1913; General Superintendent of Traffic, January, 1914; Staff Engineer, December, 1925; Engineer, Southern Area, January, 1, 1929.

NORTHERN AREA

*A. Schultz appointed General Manager.*

Entered employ of the Bell System as Engineer's Assistant, Bell Telephone Company of Pennsylvania, Philadelphia, July, 1909; Specification Writer, January 1, 1911; Specification Clerk, January 11, 1911; Harrisburg, February, 1911; Equipment Engineer, Oc-



## *Organization Changes*

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tober, 1911; Plant Engineer, August, 1913; Plant Engineer, Central District Telephone Company, Pittsburgh, March, 1918; Engineer of Equipment, Bell Telephone Company of Pennsylvania, Philadelphia, December, 1919; Engineer of Outside Plant, October, 1920; Division Superintendent of Installation, Western Electric Company, March, 1923; New York City, December, 1923; General Plant Manager, New England Telephone and Telegraph Company, Boston, December, 1925; General Manager, Northern Area, January 1, 1929.

### *J. E. Harrell appointed General Traffic Manager.*

Entered employ of the Bell System as Clerk, American Telephone and Telegraph Company, Long Lines Department, Atlanta, Ga., June, 1913; Apprentice, New York City, August, 1913; Traffic Clerk, February, 1914; Atlanta, March, 1914; Assistant to Traffic Chief, Louisville, Ky., October, 1915; Memphis, June, 1916; Louisville, August, 1916; District Traffic Chief, Nashville, November, 1916; Memphis, March, 1919; District Traffic Superintendent, February, 1920; Detroit, May, 1922; Cleveland, May, 1924; New York City, November, 1924; General Toll Traffic Supervisor, New England Telephone and Telegraph Company, Boston, October, 1925; Division Superintendent of Traffic, Springfield, February, 1926; General Supervisor of Traffic, Boston, April, 1927; General Traffic Manager, Northern Area, January 1, 1929.

### *C. N. Tasker appointed General Plant Manager.*

Entered employ of the Bell System as Inspector, New England Telephone and Telegraph Company, Central Division, October, 1900; Service Inspector, New Bedford, 1902; Division Inspector, Southern Massachusetts, 1903; Foreman of Maintenance, New Bedford, 1906; Division Inspector, Southern Massachu-

setts, 1906; District Foreman, New Bedford, 1906; Foreman, 1907; District Foreman, 1908; District Plant Chief, October, 1908; Acting Division Superintendent of Plant, Portland, Me., January, 1918; Division Superintendent of Plant, Springfield, October, 1918; General Superintendent of Plant, Boston, December, 1922; General Plant Manager, August, 1923; Division Superintendent of Plant, December, 1925; Providence, March, 1926; General Plant Manager, Northern Area, January 1, 1929.

*B. T. Miller appointed General Commercial Manager.*

Entered employ of the Bell System as Student, Colorado Telephone Company, Denver, October, 1910; Student and Manager, May, 1911; Assistant Manager, July, 1911; Assistant Manager, Mountain States Telephone and Telegraph Company, January, 1912; Manager, July, 1912; Traveling Service Observer, Salt Lake City, May, 1914; District Traffic Chief, Boise, Ida., June, 1915; Pocatello, Ida., March, 1915; Division Traffic Supervisor, Salt Lake City, November, 1917; City Traffic Manager, February, 1918; District Traffic Chief, April, 1919; Denver Traffic Manager, Denver, October, 1919; District Traffic Chief, April, 1920; Denver Traffic Chief, May, 1921; Denver Traffic Superintendent, May, 1923; Acting Division Superintendent, New England Telephone and Telegraph Company, Worcester, December, 1923; Division Superintendent of Traffic, Springfield, September, 1924; General Supervisor of Traffic, Boston, February, 1926; Division Manager, Providence, May, 1927; General Commercial Manager, Northern Area, January 1, 1929.

*F. A. Benham appointed Engineer.*

Entered employ of the Bell System as Plant Engineering Assistant, New England Telephone & Tele-

graph Company, Boston, July, 1906; Engineer, November, 1913; Engineer, Northern Area, January 1, 1929.

SOUTHWESTERN BELL TELEPHONE COMPANY

*A. C. Stannard appointed Vice-President.*

Entered employ of the Bell System as Night Operator, American Telephone and Telegraph Company, Springfield, Mass., 1899; Chief Operator and Service Inspector, New England Telephone and Telegraph Company, White River, Springfield and Boston, 1901; Traffic Department, Southern Bell Telephone Company, Atlanta, Ga., 1903; Traffic and Tariff Department, American Bell Telephone Company, Boston, Mass., 1906; Traffic Engineer, Pacific Telephone and Telegraph Company, San Francisco, Cal., January, 1908; Division Superintendent of Traffic, January, 1914; Acting General Superintendent of Traffic, Chesapeake & Potomac Telephone Company, Baltimore, Md., August, 1918; General Superintendent of Traffic, May, 1919; General Traffic Manager, Southwestern Bell Telephone Company, St. Louis, Mo., January, 1921; Vice-President, September, 1928.

*F. M. Hoag appointed Vice-President.*

Entered employ of the Bell System as Cable Helper, Cleveland Telephone Company, Cleveland, O., 1898; Splicer, 1899; Foreman, 1900; General Foreman of Construction, 1902; Inspector, Engineering Department, Southwestern Telephone and Telegraph Company, Dallas, Tex., 1903; Construction Engineer, 1905; Assistant Plant Engineer, October, 1909; Construction Supervisor, January, 1912; Division Superintendent of Plant, July, 1913; Division Plant Superintendent, December, 1915; and at San Antonio, May, 1917; Plant Supervisor, Dallas, June, 1919; General Plant Superintendent and State Engineer, Southwestern Bell Telephone Company, Oklahoma City, Okla., May, 1920;

title changed to Plant Superintendent, September, 1920; State Engineer and Assistant General Manager, October, 1920; General Manager, Dallas, Tex., April, 1921; General Commercial Manager, St. Louis, September, 1926; Vice-President, September, 1928.

*W. L. Holley appointed General Traffic Manager.*

Entered employ of the Bell System as Traffic Student, Pacific Telephone and Telegraph Company, Los Angeles, August, 1910; District Traffic Chief, Santa Barbara, January, 1912; Traffic Chief, Los Angeles, April, 1913; Traffic Supervisor, Chesapeake & Potomac Telephone Company, Baltimore, Md., December, 1918; Acting Division Traffic Superintendent, July, 1919; Division Traffic Superintendent, October, 1919; General Supervisor of Traffic, Southwestern Bell Telephone Company, St. Louis, April, 1921; Traffic Superintendent, December, 1923; General Supervisor of Traffic, August, 1925; Engineer, American Telephone and Telegraph Company, New York City, May, 1927; General Traffic Manager, Southwestern Bell Telephone Company, St. Louis, October, 1928.

NEW JERSEY BELL TELEPHONE COMPANY

*A. P. Monroe appointed General Traffic Manager.*

Entered employ of the Bell System as Inspector, Bell Telephone Company of Pennsylvania, Philadelphia, October, 1911; Traffic Inspector, March, 1912; Assistant Traffic Supervisor, August, 1913; at Allentown, July, 1915; Traffic Supervisor, Philadelphia and Camden, N. J., August, 1915; District Traffic Superintendent, September, 1915; on furlough for military service, September, 1917 to August, 1919; District Traffic Manager, New York Telephone Company, New York City, February, 1920; Supervisor of machine switching, February, 1925; Service Superintendent, April, 1926; Division Superintendent of Traffic, May,



1927; General Supervisor of Traffic, November, 1927; General Traffic Supervisor, May, 1928; General Traffic Manager, New Jersey Bell Telephone Company, Newark, N. J., October, 1928.

PACIFIC TELEPHONE AND TELEGRAPH COMPANY

*Frank J. Reagan appointed Vice-President in charge of Publicity and Personnel.*

Entered employ of the Bell System as Traffic Inspector, New England Telephone Company, Boston, August, 1909; Traffic Department Clerk, Pacific Telephone and Telegraph Company, San Francisco, February, 1910; Supervisor of Traffic Inspection, September, 1911; Traffic Supervisor, May, 1913; General Supervisor of Traffic, February, 1920; Division Superintendent of Traffic, February, 1922; General Traffic Manager, New York Telephone Company, Albany, July, 1925; General Commercial Manager, for Northern California and Nevada, Pacific Telephone and Telegraph Company, San Francisco, June, 1926; Assistant to the President, in charge of Publicity, August, 1928; Vice-President in charge of Publicity and Personnel, January 1, 1929.

*J. H. Corcoran appointed General Manager, Northern California and Nevada Area.*

Entered employ of the Bell System as Messenger, Pacific Telephone and Telegraph Company, San Francisco, 1887; Operator, Sunset Telephone and Telegraph Company, 1887; Repairer and Inspector, Pacific Telephone and Telegraph Company, 1887; Installer, 1889; Wire Chief, 1892; Wire Chief, Sunset Telephone and Telegraph Company, Los Angeles, 1895; Exchange Manager, Santa Barbara, 1897; Exchange Manager, Pacific Telephone and Telegraph Company, 1899; Exchange Manager, Sunset Telephone and Telegraph Company, San Jose, 1900; Division Manager, Central

Union Telephone Company, Indiana, 1902; Sunset Telephone and Telegraph Company, Seattle, 1903; Pacific Telephone and Telegraph Company, Seattle, 1907; Division Superintendent of Traffic, San Francisco, August, 1908; Portland, Ore., January, 1914; Acting General Superintendent of Traffic, San Francisco, December, 1919; General Superintendent of Traffic, December, 1920; General Traffic Manager, January, 1926; General Manager, Northern California and Nevada Area, October, 1928.

*M. R. Sullivan appointed General Traffic Manager, Northern California and Nevada Area.*

Entered employ of the Bell System as Clerk, Pacific Telephone and Telegraph Company, San Francisco, March, 1912; Traffic Inspector, August, 1913; Chief Clerk, March, 1917; Division Traffic Agent, August, 1918; Division Traffic Supervisor, January, 1919; Traffic Supervisor, May, 1921; General Supervisor of Traffic, February, 1922; General Toll Supervisor, July, 1925; General Traffic Supervisor, January, 1927; General Traffic Manager, Northern California and Nevada Area, November, 1928.







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## The Dial Office "Cutover"

SINCE the advent of dial service in the Bell System, a new word is coming more and more into use. It is "Cutover." Its use is not confined to telephone workers. Telephone users, whose service has been changed from manual to dial, have encountered the word and have used it. More than 3,100,000, or 21.7 percent of the Bell owned stations, were served by central office equipment of the dial type at the end of 1928, and for more than 2,000,000 of these there was a transfer from manual to dial service. A great many people by this time know the word "Cutover" and the change in service associated with it.

What is a "Cutover"? In instances where the Bell System has acquired a dial plant with a numbering plan inadequate for the entire service in the city, the cutover has involved an expansion of the numbering plan so as to comprehend service to all the telephones in the city, the introduction of an additional train of switches in a working plant, and an increase in the number of pulls of the dial necessary to call a number. In general, however, a cutover involves the transfer of part or all of the subscribers in a given manual office to a

new dial office. The dial equipment may be in the same building with the manual, or it may be in a new building a block or even a mile away.

To the layman, perhaps the most impressive type of cutover is the one that involves a transfer of the service from one building to another. It is mystifying to understand how the thousands of lines involved may be working in a manual office until nearly midnight on the day of the cut and at midnight they are all working in the new office with each line in its proper place. "How long does it take?" "How is it done?" "Are the lines cut off from service altogether?" "Isn't it very dramatic?" These are some of the questions that are asked.

Does a cutover have any drama? For the casual observer, no. It is not physically possible to watch all the steps involved in making a given cut. The time intervals between steps are too short to allow one to travel from point to point. Even actual observation of each step would not be sufficient, for it would be necessary for the mind to build up a picture of what each step signified.

But to the men and women engaged in the work, there is all the thrill that a First Night at the theatre has for the cast—and more. Actors rehearse for a few weeks, but the telephone operating forces have been in training for months, and work on the job has been in progress for a year or two. If actors fail to provide entertainment, they seek another vehicle for their efforts. But the principals in a telephone cutover cannot fail, and their audience—the telephone users—is the most critical in the the world. Their mistakes would disturb a service that is essential to the community. They have been rehearsed in each step in the cutover program. They have their cues. They all know that the success of the job requires that each one perform his or her allotted task at the assigned time. Pride of

craft requires that each one will not be found wanting. Indeed there is drama—plenty of it.

#### PREPARATORY WORK

Suppose we consider some of the major steps leading up to the cut, and then, eliminating time and distance, attend all points of interest. For example, an old manual equipment in an old building is to be replaced with dial equipment in a new building some blocks from the old one. A sufficient amount of equipment is engineered and ordered to care for the growth in that area for two years from the date when the new office goes into service. The new building is started and both telephone people and customers, located in that area, are interested in watching it grow. The operations are so timed that by the time the building is finished, the equipment is delivered and the installers are at work.

While this work is in progress, the Plant forces are busy building the underground conduit and installing cables so that the subscribers' lines and the inter-office trunks may be connected to the new office. In due time each subscriber's line served by the old office is spliced to a cable pair leading to the new office. This is all done before the cutover takes place. Steps are taken to be sure that each line is in its proper place in the new office before it is cut from the old.

While these steps are in progress, many others are under way, all of them being timed so that they are completed at the proper date with reference to the cutover. The various private branch exchange boards must be replaced with new boards that will work properly with the new dial equipment. Along with these changes, it is frequently necessary to change the night service arrangements required by the subscriber, these changes involving both equipment and directory listings.

The Plant forces must replace all the manual instruments in the area with dial instruments, and must assure themselves that it is possible to dial satisfactorily from each instrument over the subscriber's primary loop to the central office. If a given line is found to be unsatisfactory, the condition must be corrected. Nothing is left to chance. By the time the cutover occurs, there must be assurance that each telephone is connected to the assigned terminal in the office, and that it is possible to dial from that telephone over the subscriber's line into dial equipment that will work in accordance with design.

Several months before the new office is cut into service, the traffic engineers must complete the work of assigning each line to the proper terminals in the new office so that adequate provision is made for the normal calls from and to each subscriber. This involves a study of the requirements for each class of subscribers as well as individual assignments for each subscriber. This work involves many number changes but no unnecessary ones are made. Where number changes are necessary, steps are taken to make them so as to cause the minimum inconvenience to the subscribers affected.

The Plant men who must cut over the new office and maintain it receive their training for several months preceding the cut. As the new dial office requires operators to handle toll calls to nearby towns, to assist customers who have had difficulty, and to handle calls for numbers that have been changed or discontinued, it is necessary to train some of the manual operators in the duties they will have to perform when the new equipment is cut into service. This work is in progress for several weeks preceding the cutover.

Of course the change from manual to dial service makes it necessary for the customer to understand the new method of placing his call and the day, hour, and minute when this change becomes effective. This work of public instruction is carefully planned and executed.



In a good many cases it involves a visit to the premises of each subscriber and a thorough explanation of the method of dialing. The work is not considered complete until the subscriber has actually dialed some practice calls under the supervision of a telephone representative.

Shortly before the cutover takes place, the Plant forces conduct a series of tests from the multiple in the old office to the terminals in the new office to make sure that each subscriber is actually connected to the terminal in the new office to which he has been assigned.

The above paragraphs do not cover all the steps involved in a specific cutover but perhaps they will give an idea of the many important activities under way and the thought that is given to the responsibility of co-ordinating all of them so as to complete them neither too early nor too late.

#### TRANSFER OF TRUNKS

As the day of the cutover arrives, there is an undercurrent of tenseness that cannot be wholly concealed by the smiles with which the men and women on the job greet the visitor. A visit to the old manual office is interesting. The operators are busy, but they seem to handle the old equipment tenderly. Some of them are tearful. Subscribers have called up to say good-bye, to apologize for cross words, and to express thanks for good service. A supervisor smiles a greeting with glistening eyes. The chief operator tells what the service index is for the month to date, and it is evident that she did not let the service slump even though her force was to be scattered. She tells of the good-bye party that was held the evening before and admits that most of the operators cried over the breaking up of old associations. All welcome the new but there is a little pang at parting from the old.

Over in the new office there are some cutover activities under way on Saturday afternoon. The inter-

office trunk plant is gradually being transferred from the old office to the new as the traffic lightens. On previous Saturdays, records were taken of the way the traffic declines on a Saturday afternoon and evening, and estimates have been made of the number of trunks in each group that may be released each half hour, beginning about twelve noon. The Traffic and Plant men have agreed not only as to the number of trunks in each group that may be released at each interval but have selected the specific trunks. These trunks are listed. Traffic men in each office arrange to put them out of service a few minutes before they are scheduled to be cut. These operations are co-ordinated by a Traffic Dispatcher at a Private Branch Exchange section located alongside another one which is used by the Plant Dispatcher. When the Traffic Dispatcher has received an O.K. from each office on the trunks to be released at a given time, he clears with the Plant Dispatcher who gives the Plant men at each office orders to proceed with the scheduled operations. This process goes on all afternoon and evening up to eleven o'clock, by which time about ninety percent of the trunks have been cut to the new office without creating any trunk shortage in the old office.

The casual visitor would be little interested in this work. There is nothing spectacular about it. A word or two from the Dispatchers to each office is sufficient. And yet real happiness shows in the faces of the men who have planned and executed this work when they have completed the transfer of an ample supply of trunks to the new office without holding up a single call to or from the old office because of a trunk shortage. For them the day is full of drama. Loss of sleep and even serious illness are not sufficient to keep them from executing the plans that they have set up. Pride of craft is indeed strong among telephone men and women.

## THE CUTOVER

The first cutover in a given city is usually scheduled for midnight on a Saturday. The traffic is light at that hour. There is little use of business telephones on Sunday, thus widening the margin for curiosity calls from residence customers. The Plant and the Traffic forces need Sunday to be sure that everything is running smoothly and is in readiness for a heavy load on Monday. Then too there is little possibility that some telephone users will confuse midnight with some other hour.

As the hour of the cut draws near, there is evidence of something unusual at both the old and the new buildings. Many cars are parked before both buildings. Lights shine through all the windows. A visit to the old operating room shows the usual night force at the board for handling the usual light Saturday night traffic. But one notices that every operator is dressed in her "Sunday best." Most of them never had any experience with a cutover and they are not sure about the attendant ceremonies, but, whatever happens, they wanted to be dressed for it. They are a little excited, and when at eleven fifty, they get word to start a scheduled step in the cut, their voices tremble as they cut in on each talking connection and advise the customers that "We are about to cut over the new dial office." The same information is given on new calls. If an emergency call is encountered, steps have been taken to handle it at the new office if it is interrupted by the cut.

At the main frame downstairs, men are stationed at close intervals. Cords run behind the heat coils. At a word over the telephone from the Dispatcher, the man in charge signals his lieutenants who in turn pass the word to the men to "PULL. TAKE IT EASY." As each man takes hold of the cord at the bottom of the bay and pulls, a barrage of heat coils comes flying from the

frame. Goggles or a visor protect the eyes of each man.

Of all the cutover operations, this one is perhaps the most spectacular to the casual visitor. It is of even greater interest to the men. In all the years that they have worked in that office, their problem has been to maintain service, but with a rip they have torn out all the heat coils and there are no subscribers connected with that office. When telephone men do a job so foreign to their regular work of maintaining the service, it bespeaks their confidence in the soundness of the plans that have been set up. The operation is over in thirty seconds. The man in charge reports completion to the Dispatcher.

This particular cut involves the severing of certain cables in the cable vault at the old building. The quarters there are crowded but the men who are to do the cutting are lined up outside, each man equipped with a small ax. In a few moments they will be required to perform an unusual task. Their job has been to install and to maintain those cables. In a moment they will take an ax to them. On signal they file into the vault and take positions to which they have been assigned. The name of each man appears at his post. The cables he is to cut have already had the sheathing removed, and all is in readiness. The man in charge receives the order from the Dispatcher, and quietly orders the men to cut. Quickly the job is done. The cable ends are fanned out so that short circuits will not be created by this operation. In a few seconds a completion report is passed to the Dispatcher.

At the new office, it is necessary to show credentials in order to enter. There are signs of activity on every floor. A trip to the basement is worth while, to inspect the new power plant and the long, straight runs of cable in the new cable vault. The contrasts with conditions in the old office are as marked here as in other parts of the building.



And now let us visit the new operating room a little before midnight. The small switchboard seems inadequate to an observer fresh from an inspection of the old one. The flowers on the Chief Operator's desk and the many visitors are evidence that something is about to happen. At a few minutes before twelve the operators file in and take their places at the board. Like those in the old office, they have dressed especially for the occasion. They, too, are somewhat tense. They have had weeks of training for their new duties. In a few minutes the curtain will rise on a new performance. Each operator wonders what type of call she will first encounter and each wants to be sure that she does the right thing on that call. Though their tenseness may be unobserved and their emotions may be unknown to the casual observer, telephone people understand. In a few minutes some lamps at the board will light. Hands may tremble a little—it will be like a "first night." But the confidence will come at once. The operators will be ready. They always are.

At the line finder frames in the new Switch Room, small insulating wedges were inserted in the cut-off relays a few days before the cutover, so that the equipment in the new office would not be affected by any calls that the subscriber might originate so long as the old office was in service. Each of these small wedges has a hole in it, and groups of them are strung together. A few minutes before midnight, a group of men file in and take their places before these frames. The man in charge is at the telephone. His lieutenants stand at the end of each row of frames where they can see him and also see their men. At the scheduled time, the signal from the Dispatcher is relayed to the men at each frame. They quietly pull the cords, removing the wedges. Midnight strikes. The new office is in service, and the switches begin to move as telephone users dial their calls. An office has been cut over.

As a part of the over-all picture of every cutover

there are, for those who look for them, little close-ups that give a human touch to what may seem to the casual observer merely a matter of routine. A certain cut-over, for example, involved the advance delivery of a new directory, accompanied by a request that the old directory be used until midnight of the day of the cutting in of the new equipment, and that the new one be used thereafter. The subscribers had been asked to destroy the old directory and the transmitter card as soon as possible after midnight. One of them dialed "Operator" a minute after midnight to make the following report of his share in the success of the cutover: "I burn up my old directory. I tear up the card on my telephone. I use my new directory. I done everything you told me to. All right to go to bed now?"

Gratefully, he is assured that his part of the job is done. Gratefully, because such calls are evidence of a desire on the part of the public to co-operate with the telephone people in making service go smoothly. Such calls are by no means exceptional. One or more cases of this sort are encountered in almost every directory cut.

#### THE CENTER OF CUTOVER ACTIVITIES

Let us enter the new terminal room on the night of a cutover. Near the Dispatcher's desk is a knot of men, talking quietly to each other. They are the men who have been intimately concerned with planning for the cutover and in the preliminary preparations for what is about to take place. Curiously proud of their part of the job, they are—yet curiously generous in sharing credit with others. The Plant men give us detailed figures that tell of the fine condition of the equipment—and then modestly attribute this to the good work done by the Western Electric Company installers. The Installation foreman tells his story of the job of getting this enormous amount of apparatus in place—but gives credit for his good record to the fine condition

of the equipment received from the factory. And so it goes, each man with a wholesome pride in his own work, but a pride that sees his work in its true proportions and as related to the work of others. All are right. As we talk with them, we begin to see this job, not as just a Division job or a Company job, but as a System job.

We wander over to the Dispatcher's desk. A lamp lights. He plugs in, speaks a word or two, and disconnects. He notes something on a sheet, plugs into another line, speaks a word or two, and disconnects, again with an entry on his sheet of paper. Many times this is repeated—until the observer begins to think of it as merely humdrum routine. Surely there is nothing dramatic in this plugging into jacks and scratching of notes on a form report.

And yet to the Dispatcher and his men about him who have been planning the job, there is in all this something extremely fascinating. These men know every step of the program. They know what work must be done at each point, how it must be done, who will do it, and when. They visualize the job, as a whole, from its beginning up to its completion, as an architect watches, from foundation to roof, the growth of a building that he has helped to create. Step by step they have done this thing that is about to be finished. They, too, are builders.

#### THE OLD PASSES

There is drama even in an empty stage, after the curtain has fallen. In the old building, the battery has been cut off the board, the lights have been extinguished, the doors locked. The man who installed that board, twenty-five years ago, was there tonight. Many of the men have worked on that equipment for years. Perhaps they realize that they, too, have been aging with the equipment. Perhaps it is because even machines, when one is long associated with them, assume some-

thing very like a personality. Any one of a dozen explanations will do for the fact that, as they leave the building on this particular night, they joke a little more noisily than usual. There is something a bit like bravado in their cheery "Good-night." But if you were to look at some of them closely, you would see that their eyes were glistening.

Perhaps there is drama in the new building, too. It has been emptied of visitors. Only the telephone people who have been assigned to night duty remain. The building is dark except where there is work to be done.

The casual visitor may have left with the feeling that there was not much of a show, and if he could return and see these people going quietly about their work, he would doubtless think that this scene was still more lacking in the spectacular. Yet, for those who have finished their part of the job, and for these who remain to carry on through the night, there is not a little of romance in this routine thing called a cut over.

They have had a part in a job that has been well done, so far. They will be back Sunday and Monday to be sure that the new office meets the test of a commercial load. They have done a job that measures up to the standards of the System and to their own exacting standards. They will see this job carried on, and neither personal affairs nor lack of sleep, nor bodily weariness, nor even ill health can stop them. You can not make such people, engaged in such a work, believe that their job is a humdrum one.

But unless you can see their job through their eyes, there is nothing dramatic about a cutover.

A. E. VAN HAGAN.



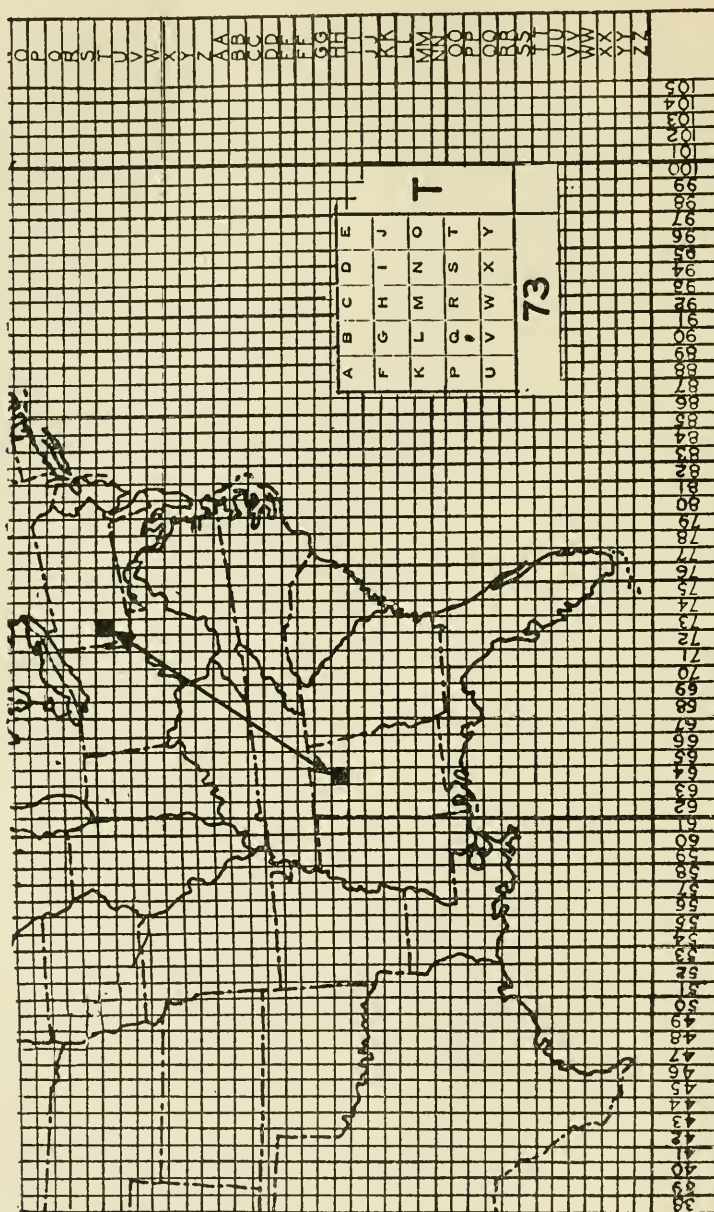
## Seven Billion Toll Rates

**I**N the early eighties when the telephone was beginning to reach out and to cover territory neighboring Boston, figuring long distance toll rates was hardly more than a matter of pad and pencil and the cost next to nothing. Assuming 40 or 50 towns receiving toll service, there might have been, all told, 2,000 rates involved. A little measuring on a map, a few computations, and presto! a new set of tariffs.

Today, however, there are over 88,000 points on the lines of the Bell System and its connecting companies in North America and in order that each of these points may have the necessary long distance rates to each of the other 87,999 points involves setting up a total of over 7,700,000,000 station-to-station day rates, from which are derived an additional 31,000,000,000 rates for other classes of service.

If these 7,700,000,000 station-to-station day rates, now necessary for our business, were to be determined by the old method, the total cost would amount to several million dollars and the time required with, say a 1,000 clerks on the job, would be several years.

An example of modern preparation and issuing of rates was given in connection with the change in toll rates made effective February 1, 1929. This change affected many of the toll rates of all the 88,000 points in the Bell System. Work on the new rates was started about October 15, 1928, and the rates were completed and in the hands of the operators ready for use February 1, 1929, the total time required being about  $3\frac{1}{2}$  months. There were over the country possibly 500 people on the assignment, only a portion of whom worked the entire  $3\frac{1}{2}$  months and the total cost was probably not over \$200,000. This was made possible principally through the use of a group or block system in computing and setting up the new rates.



This sketch illustrates the arrangement of the blocks and sections and the numbering scheme used.

The block system used by the Bell System and Connecting Companies has been laid out to include the entire continent. The blocks, seven miles square, and the sections (a group of 25 blocks), 35 miles square, have been plotted on maps obtained from the United States Government at Washington, the Canadian Government at Ottawa, and the Mexican Government at Mexico City. A suitable numbering scheme is used to designate each block and section of the system and for rate purposes, each city is assigned the block and section number of the particular block and section in which it is located.

Toll rates under this system are determined by three methods. Up to 40 miles rates are based on the direct air line distance between the points as measured on the government maps. Between 40 and approximately 350 miles rates are based on the computed air line distance between the centers of the seven-mile blocks and all points in a block take the same block rates. Finally, for distances greater than 350 miles the rates are based on the air line distance between the centers of the 35-mile sections and all points in a section take the same section rates. As the blocks and the sections used are the same size throughout the continent, the same rates for equal distances are always obtained under a given rate schedule. Therefore, under a given rate schedule the charts can be printed in quantities from a single set up of type and used anywhere, it being necessary only to give them the proper block and section designations to make them applicable to a particular locality.

The toll tariffs as set up for use of the operators, the accounting departments and commercial offices, contain in each case a List of Stations, a First Reference List, Block Rate Charts, Section Rate Charts and a Table of Rates. The First Reference List shows the names and station-to-station day rates to all points within 40 miles where the direct air line rate applies

EFFECTIVE JULY 21, 1927. LIST OF STATIONS ALABAMA

NOTE: In Toll Center column first entry is for Long Lines traffic. In Toll Center column all entries are for Associated Company traffic.

| STATION               | USE RATE TO       | TOLL CENTER                                     | STATION                | USE RATE TO              | TOLL CENTER                              |
|-----------------------|-------------------|-------------------------------------------------|------------------------|--------------------------|------------------------------------------|
| Abanda (54)           | JJ 66-f           | { La Grange, Ga.<br>Ref. Roanoke★<br>Montgomery | Baltzell               | KK 62-s                  | { Selma<br>Ref. Demopolis★<br>Birmingham |
| Abbeville             | MM 67-c           | { Ref. Dothan★<br>Mobile Springs                | Bangor                 | HH 64-w                  | Jasper (II 63-d)                         |
| Abbot (Mobile Co.)    | OO 62-s           | Union Springs (LL 66-d)                         | Bankhead               | Jasper (II 63-d)         | Jasper                                   |
| Aberfoil              | JJ 62-e           | Snow Hill (LL 64-r)                             | Banks                  | LL 66-w                  | Troy                                     |
| Abernant              | KK 64-b           | Selma                                           | Barachias              | II 63-k                  | Jasper                                   |
| Ackerville            | KK 65-f           | Montgomery                                      | Barneville             | Montgomery (KK 65-w)     | Montgomery                               |
| Ada                   | KK 65-f           | Fort Payne                                      | Barney Mines           | HH 62-q                  | Jasper                                   |
| Adamsburg             | Sixespe (GG 66-u) | Birmingham                                      |                        | Cordova (II 63-j)        | { Birmingham★<br>Ref. Dora★              |
| Adamsville            | JJ 64-a           | Eutaw                                           | Barnwell (Baldwin Co.) | OO 63-v                  | Fairhope                                 |
| Adger (Lock Eight)    | KK 63-a           | Gadsden                                         | Barnwell (Walker Co.)  | Dora (II 63-j)           | { Birmingham★<br>Ref. Dora★              |
| Alabama City          | JJ 64-h           | Birmingham                                      | Barton                 | GG 62-m                  | Sheffield                                |
| Alabaster             | GG 63-t           | Albany                                          | Bartonville            | Birmingham (II 64-r)     | Birmingham                               |
| ALBANY (54)           | LL 63-f           | Selma                                           | Bassi                  | LL 62-y                  | Thomasville                              |
| ALBERTVILLE (35)      | HH 65-b           | Albertville                                     | Batesville             | Stevenson (FF 65-y)      | Stevenson                                |
| Alco (Tuscaloosa Co.) | JJ 63-f           | Tuscaloosa                                      | Battle Ground          | LL 67-g                  | Eufaula                                  |
| Aldrich               | JJ 64-m           | Calera                                          | Battles                | Leulani Church (HH 64-f) | Cullman                                  |
| ALEXANDER CITY        |                   |                                                 |                        | Fairhope (OO 63-p)       | Fairhope                                 |
|                       |                   |                                                 |                        |                          | Mobile                                   |

Portion of "List of Stations."  
Note Bangor's Block Number.



## Seven Billion Toll Rates

### FIRST REFERENCE LIST TOLL RATES

FROM Pittsburgh

| TO           | STATION<br>TO<br>STATION | PERSON<br>TO<br>PERSON | REPORT<br>CHARGE | TO         | STATION<br>TO<br>STATION | PERSON<br>TO<br>PERSON | REPORT<br>CHARGE |
|--------------|--------------------------|------------------------|------------------|------------|--------------------------|------------------------|------------------|
| La Grange    | 10                       | 20                     | 10               | Palatine   | 20                       | 30                     | 10               |
| Lake Forest  | 1.25                     | 1.55                   | 30               | Palos Park | 15                       | 25                     | 10               |
| Lake Villa   | 1.40                     | 1.75                   | 35               | Park Ridge | 10                       | 20                     | 10               |
| Lake Zurich  | 25                       | 35                     | 10               | Peoria     | 1.80                     | 2.25                   | 45               |
| Lansing      | 20                       | 30                     | 10               | Pistakee   | 35                       | 50                     | 10               |
| Lemont       | 15                       | 25                     | 10               | Plano      | 1.35                     | 1.70                   | 35               |
| Libertyville | 30                       | 40                     | 10               | Plattville | 35                       | 50                     | 10               |
| Lockport     | 20                       | 30                     | 10               |            |                          |                        |                  |
| Lombard      | 15                       | 25                     | 10               |            |                          |                        |                  |
| Lyons        | .10                      | 20                     | 10               |            |                          |                        |                  |

and also the names and station-to-station day rates to all points to which there is any appreciable volume of traffic. (a) The List of Stations shows the names of each of the 88,000 points reached over the Bell System and with each name the number of the block and section in which the point is located. (b) The Block Charts show the station-to-station day rates for points from 40 to 350 miles distant and the Section Charts the station-to-station day rates for points more than 350 miles distant. The Table of Rates contains the corresponding rates for classes of service other than station-to-station, for each station-to-station day rate from 10 cents to 20 dollars.

With this material set up for a particular point, the rate may be determined from that point to any one of the other 87,999 points in the List of Stations. For example: Assume that a Pittsburgh operator desires the station-to-station day rate from Pittsburgh, Pa., located in Section T73, Block q, written T73-q, to Bangor, Ala. She will not find Bangor with its rate in her First Reference List as the distance is more than 40 miles and there is no appreciable volume of traffic. She will, therefore, obtain the number of the block in which Bangor is located, HH64-w, from her List of Stations and after first finding that this block is not shown on her block rate charts, the distance being more

## BLOCK RATES FROM

|          | 73 |    |    |    |    | 74 |    |    |    |    | 75 |    |    |    |    | 76 |    |    |    |    |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <b>T</b> | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  |
|          | 20 | 20 | 20 | 25 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 60 | 65 | 70 | 75 | 75 | 80 | 80 | 80 |
|          | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  |
|          | 15 | 15 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 55 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 |
|          | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  |
|          | 10 | 10 | 10 | 15 | 20 | 25 | 30 | 40 | 45 | 50 | 50 | 55 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 |
| <b>U</b> | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  |
|          | 10 | X  | 10 | 15 | 20 | 25 | 30 | 35 | 45 | 45 | 50 | 55 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 |
|          | U  | V  | W  | X  | Y  | U  | V  | W  | X  | Y  | U  | V  | W  | X  | Y  | U  | V  | W  | X  | Y  |
|          | 10 | 10 | 10 | 15 | 20 | 25 | 30 | 40 | 45 | 50 | 50 | 55 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 |
|          | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  | A  | B  | C  | D  | E  |
|          | 15 | 15 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 55 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 |
| <b>V</b> | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  | F  | G  | H  | I  | J  |
|          | 20 | 20 | 20 | 25 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 60 | 65 | 70 | 75 | 75 | 80 | 80 | 80 |
|          | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  | K  | L  | M  | N  | O  |
|          | 25 | 25 | 25 | 30 | 30 | 35 | 40 | 45 | 50 | 50 | 55 | 60 | 65 | 65 | 70 | 75 | 75 | 80 | 80 | 80 |
|          | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  | P  | Q  | R  | S  | T  |
|          | 30 | 30 | 30 | 35 | 35 | 40 | 45 | 45 | 50 | 55 | 60 | 60 | 65 | 70 | 70 | 75 | 80 | 80 | 80 | 80 |

Portion of Block Chart. Arrow Indicates Rate From Block T73-q to Block V75-g.

than 350 miles, will, by reference to the grid of her section rate chart, locate the section HH64. In this section she will find printed in red ink the rate \$2.35. Rate charts show only the initial period rates for station-to-station day service and reference is made to the Table of Rates to determine the corresponding rate for other classes of service and for overtime after first determining the station-to-station initial rate as described.

SECTION RATES FROM

SECTION No. T 73  
SHEET NO. 1

|     | 72  | 71  | 70  | 69  | 68  | 67  | 66  | 65  | 64  | 63  | 62  | 61  | 60  | 59  | 58  | 57  | 56  | 43  | 42  |    |   |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|---|
| 73  | 74  | 75  | 76  | 77  | 78  | 79  | 80  | 81  | 82  | 83  | 84  | 85  | 86  | 87  | 88  | 89  | 90  | 103 | 104 |    |   |
| X   |     |     |     |     |     |     |     |     |     | 160 | 170 | 180 | 195 | 205 | 215 | 235 | 235 | 375 | 400 | T  |   |
|     |     |     |     |     |     |     |     |     |     | 160 | 170 | 180 | 195 | 205 | 215 | 235 | 235 | 400 | 400 | U  | S |
|     |     |     |     |     |     |     |     |     |     | 165 | 170 | 180 | 195 | 205 | 215 | 235 | 235 | 400 | 400 | V  | R |
|     |     |     |     |     |     |     |     |     |     | 165 | 175 | 185 | 195 | 205 | 215 | 235 | 235 | 400 | 400 | W  | Q |
|     |     |     |     |     |     |     |     |     |     | 165 | 175 | 195 | 205 | 215 | 235 | 235 | 375 | 400 | 400 | X  | P |
|     |     |     |     |     |     |     |     |     | 165 | 170 | 180 | 195 | 205 | 215 | 235 | 235 | 375 | 400 | 400 | Y  | O |
|     |     |     |     |     |     |     |     |     | 170 | 175 | 185 | 195 | 205 | 215 | 235 | 235 | 375 | 400 | 400 | Z  | N |
|     |     |     |     |     |     |     |     | 165 | 175 | 185 | 195 | 205 | 215 | 235 | 235 | 235 | 375 | 400 | 400 | AA | M |
|     |     |     |     |     | 165 | 170 | 175 | 180 | 195 | 205 | 215 | 235 | 235 | 235 | 235 | 235 | 375 | 400 | 400 | BB | L |
| 160 | 160 | 165 | 165 | 165 | 170 | 175 | 185 | 195 | 205 | 215 | 235 | 235 | 235 | 235 | 235 | 235 | 375 | 400 | 400 | CC | K |
| 170 | 170 | 170 | 175 | 175 | 180 | 185 | 195 | 205 | 215 | 235 | 235 | 235 | 235 | 255 | 255 | 255 | 375 | 400 | 400 | DD | J |
| 180 | 180 | 180 | 185 | 195 | 195 | 195 | 205 | 205 | 215 | 235 | 235 | 235 | 235 | 255 | 255 | 255 | 375 | 400 | 400 | EE | I |
| 195 | 195 | 195 | 195 | 205 | 205 | 205 | 215 | 215 | 235 | 235 | 235 | 235 | 255 | 255 | 255 | 255 | 375 | 400 | 400 | FF | H |
| 205 | 205 | 205 | 205 | 215 | 215 | 215 | 235 | 235 | 235 | 235 | 235 | 255 | 255 | 255 | 255 | 255 | 375 | 400 | 400 | GG | G |
| 215 | 215 | 215 | 215 | 235 | 235 | 235 | 235 | 235 | 235 | 235 | 235 | 255 | 255 | 255 | 255 | 255 | 375 | 400 | 400 | HH | F |
| 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | 225 | II | E |
|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | LL | D |

Portion of Section Chart. Arrow Indicates Rate from Section T73 to Section HH64.

# **RATE TABLE** Corresponding Rates for different Classes of Service

| STATION to STATION     |         |               |         |        | STATION to STATION |         |             |             |             | PER - PER |         | RPT<br>CHG |         |
|------------------------|---------|---------------|---------|--------|--------------------|---------|-------------|-------------|-------------|-----------|---------|------------|---------|
| Day, Evening and Night |         | Initial       |         |        | Day                |         | Evening     |             | Night       |           | APT, MG |            |         |
| 3 Mins                 | Add Min | 3 Mins        | Add Min | 3 Mins | 3 Mins             | Add Min | 3 Mins      | Add Min     | 3 Mins      | Add Min   | 3 Mins  |            | Add Min |
| .10 - 5 mins.          |         | .05 - 3 mins. |         | .10    | 3.50 to 3.70       | 1.00    | 2.80 - .90  | 1.90 - .60  | 4.50 - 1.50 | .90       |         |            |         |
| .15 - 5 "              |         | .05 - 2 "     |         | .10    | 3.75 "             | 1.25    | 3.00 - 1.00 | 2.00 - .65  | 4.75 - 1.50 | .95       |         |            |         |
| .20 - 5 "              |         | .05 - 2 "     |         | .10    | 4.00 to 4.20       | 1.25    | 3.25 - 1.00 | 2.25 - .75  | 5.00 - 1.50 | 1.00      |         |            |         |
| .25 - 5 "              |         | .05 - 1 "     |         | .10    | 4.25 "             | 1.25    | 3.50 - 1.00 | 2.50 - .80  | 5.25 - 1.75 | 1.00      |         |            |         |
| .30 - 3 "              |         | .10 - 1 "     |         | .10    | 4.50 "             | 1.50    | 3.75 - 1.25 | 2.50 - .80  | 5.75 - 1.75 | 1.00      |         |            |         |
| .35 - 3 "              |         | .10 - 1 "     |         | .10    | 4.75 "             | 1.50    | 4.00 - 1.25 | 2.75 - .90  | 6.00 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.00 to 5.20       | 1.50    | 4.25 - 1.25 | 3.00 - 1.00 | 6.25 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.25 "             | 1.75    | 4.25 - 1.25 | 3.00 - 1.00 | 6.50 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.50 "             | 1.75    | 4.25 - 1.25 | 3.00 - 1.00 | 7.00 - 2.25 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.75 "             | 1.75    | 4.50 - 1.50 | 3.25 - 1.00 | 7.25 - 2.25 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.00 to 6.20       | 2.00    | 4.75 - 1.50 | 3.50 - 1.00 | 7.50 - 2.50 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.25 "             | 2.00    | 5.00 - 1.50 | 3.50 - 1.00 | 7.75 - 2.50 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.50 "             | 2.00    | 5.25 - 1.75 | 3.75 - 1.25 | 8.25 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.75 "             | 2.25    | 5.50 - 1.75 | 4.00 - 1.25 | 8.50 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.00 to 7.20       | 2.25    | 5.50 - 1.75 | 4.00 - 1.25 | 8.75 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.25 "             | 2.25    | 5.75 - 1.75 | 4.25 - 1.25 | 9.00 - 3.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.50 "             | 2.50    | 6.00 - 2.00 | 4.50 - 1.50 | 9.50 - 3.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.75 "             | 2.50    | 6.25 - 2.00 | 4.50 - 1.50 | 9.75 - 3.25 | 1.00      |         |            |         |

| STATION to STATION     |         |               |         |        | STATION to STATION |         |             |             |             | PER - PER |         | RPT<br>CHG |         |
|------------------------|---------|---------------|---------|--------|--------------------|---------|-------------|-------------|-------------|-----------|---------|------------|---------|
| Day, Evening and Night |         | Overtime      |         |        | Day                |         | Evening     |             | Night       |           | APT, MG |            |         |
| 3 Mins                 | Add Min | 3 Mins        | Add Min | 3 Mins | 3 Mins             | Add Min | 3 Mins      | Add Min     | 3 Mins      | Add Min   | 3 Mins  |            | Add Min |
| .10 - 5 mins.          |         | .05 - 3 mins. |         | .10    | 3.50 to 3.70       | 1.00    | 2.80 - .90  | 1.90 - .60  | 4.50 - 1.50 | .90       |         |            |         |
| .15 - 5 "              |         | .05 - 2 "     |         | .10    | 3.75 "             | 1.25    | 3.00 - 1.00 | 2.00 - .65  | 4.75 - 1.50 | .95       |         |            |         |
| .20 - 5 "              |         | .05 - 2 "     |         | .10    | 4.00 to 4.20       | 1.25    | 3.25 - 1.00 | 2.25 - .75  | 5.00 - 1.50 | 1.00      |         |            |         |
| .25 - 5 "              |         | .05 - 1 "     |         | .10    | 4.25 "             | 1.25    | 3.50 - 1.00 | 2.50 - .80  | 5.25 - 1.75 | 1.00      |         |            |         |
| .30 - 3 "              |         | .10 - 1 "     |         | .10    | 4.50 "             | 1.50    | 3.75 - 1.25 | 2.50 - .80  | 5.75 - 1.75 | 1.00      |         |            |         |
| .35 - 3 "              |         | .10 - 1 "     |         | .10    | 4.75 "             | 1.50    | 4.00 - 1.25 | 2.75 - .90  | 6.00 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.00 to 5.20       | 1.50    | 4.25 - 1.25 | 3.00 - 1.00 | 6.25 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.25 "             | 1.75    | 4.25 - 1.25 | 3.00 - 1.00 | 6.50 - 2.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.50 "             | 1.75    | 4.25 - 1.25 | 3.00 - 1.00 | 7.00 - 2.25 | 1.00      |         |            |         |
|                        |         |               |         |        | 5.75 "             | 1.75    | 4.50 - 1.50 | 3.25 - 1.00 | 7.25 - 2.25 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.00 to 6.20       | 2.00    | 4.75 - 1.50 | 3.50 - 1.00 | 7.50 - 2.50 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.25 "             | 2.00    | 5.00 - 1.50 | 3.50 - 1.00 | 7.75 - 2.50 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.50 "             | 2.00    | 5.25 - 1.75 | 3.75 - 1.25 | 8.25 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 6.75 "             | 2.25    | 5.50 - 1.75 | 4.00 - 1.25 | 8.50 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.00 to 7.20       | 2.25    | 5.50 - 1.75 | 4.00 - 1.25 | 8.75 - 2.75 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.25 "             | 2.25    | 5.75 - 1.75 | 4.25 - 1.25 | 9.00 - 3.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.50 "             | 2.50    | 6.00 - 2.00 | 4.50 - 1.50 | 9.50 - 3.00 | 1.00      |         |            |         |
|                        |         |               |         |        | 7.75 "             | 2.50    | 6.25 - 2.00 | 4.50 - 1.50 | 9.75 - 3.25 | 1.00      |         |            |         |



## Long Toll Cable Construction and Maintenance

ONE of the most important considerations confronting the Long Lines Department of the American Telephone and Telegraph Company is the construction and maintenance of long toll cables. During 1928 there was added about 1,500 miles of cable to the network stretching across the northeastern section of the country. It is possible to talk through cable from north of Portland, Me., all the way to Greensboro, N. C., in the South, to Davenport, Ia., and St. Louis in the West, and to all important centers in the intervening territory. Construction plans for the next few years contemplate further extension of this system to the north, west, and south, and reinforcement of the existing network.

The important factors in selecting a toll cable route are avoidance of circuitous routes, freedom from power exposures and fire hazards, suitability of repeater station locations and feasibility of right-of-way from the standpoint of its cost together with the attendant construction and maintenance problems. In general, long toll cables are run on direct routes between large cities principally on private right-of-way and often through rather rough country. Some companies secure all new right-of-way on a form of grant in which the property owner agrees to construct no inflammable structure within fifty feet of the cable line. It is impracticable to secure such protection if the cable line is on a highway. Furthermore, highways also introduce existing fire hazard difficulties, and often involve later rearrangements due to highway changes. The tendency therefore is towards either all underground routes or private right-of-way aerial routes with underground through cities.

## PRELIMINARY WORK

Scheduling and programming cable construction work are important because of the length of time required to plan and construct a long toll cable. Right-of-way permits and franchises should be obtained well in advance in order to avoid delays or changes in plans after material has been ordered or loading spacing laid out. The locating and staking work should be done under the supervision of engineers having in mind the problems of the Construction Department. It is also important to complete negotiations for railroad, river and power crossings well in advance of the construction work.

## POLE LINE MESSENGER AND CONDUIT WORK

Since aerial toll cables are usually placed on new pole lines free of open wire construction, the building of a cable pole line is an undertaking which can be handled on a large scale production basis. Digging machines, tractors and air compressors may be used to advantage. Messenger and ring work follows the pole line construction and requires no special discussion. Conduit work is usually handled by contract although close supervision is required. In this connection duct assignments are an important engineering consideration in that they involve future maintenance of underground cable. Improper duct assignments lead to no end of difficulties, particularly in cities where there are large requirements for local distribution. It is important that the toll cables be placed and racked where they will be least disturbed.

## CABLE PLACING

Pulling cable in underground systems is well standardized. The placing of aerial cable, however, still partakes of many problems incident to the wide variation in local conditions surrounding its erection. In general, there are two methods, one in which cable reels

are spotted by a separate gang ahead of the cable pulling outfit, the latter outfit jacking up the reels when ready to pull, and a second method in which the cable is pulled direct from the cable reel trailer. From studies which we have made it appears that the first method is best adapted to very rough country where long hauls with tractors are necessary in order to spot the reels in difficult rights-of-way, whereas the second method saves time and expense, providing the country is relatively flat and accessible to good roads. Tractors fitted with winches, and other special equipment, are justified on large projects.

#### SPLICING

Because the cable and strand have different coefficients of expansion it is necessary to compensate for this by splicing the cable under tension whenever the temperature is below 40° F. in order to minimize buckling in subsequent hot weather. This necessitates securing the cable with a grade clamp in the middle of each length and pulling the ends of the cable together at the point where a splice is to be made. This tension stretches the cable to an amount which approximately compensates for the difference in the coefficients of expansion between the cable and strand. The tension set up also straightens the cable, eliminates curves and bends at poles and aids in preventing accumulation at these points when the cable expands under rising temperature.

#### GAS PRESSURE TESTING

Gas pressure testing is a subject in which every cable man is vitally interested. The advantages of testing out new construction work with gas pressure are generally well recognized. The method is simply one in which a completed loading section is filled with nitrogen gas before cutting in the loading, both ends of the section being capped. After the pressure is equalized, pressure gauge readings at both ends are

noted and then rechecked a day later. If the recheck indicates that gas is being lost, the several splices involved are soaped to locate the point where the gas is escaping, or the cable ridden to find a crack or puncture. The success of this method of testing out new construction has led to further experiment with a view to maintaining toll cables under gas pressure. This will be touched upon subsequently in this paper.

#### COMPLETION AND SERVICE TESTS

Completion and service tests are important considerations which should not be overlooked in scheduling a new toll cable. The completion tests are comprehensive and extensive and comprise the following measurements on all circuits:

- Insulation
- Loop resistance
- Crosstalk
- Resistance unbalances
- Impedance unbalances
- Impedance runs

Usually some errors are found and time must be allowed for clearing them. When the cable passes these tests satisfactorily it is considered completed but service tests, consisting of a check of impedance and a transmission test, must also be made for each circuit as it is put in service.

In meeting a service date there is a tendency to continue construction right up to the service date. This may be necessitated by bad weather, improper planning or delays of one sort or another which cause the Construction Department to get behind its schedule. The completion tests and the service tests suffer from delays in the construction schedule. It is important therefore to make allowances where possible for delays in order that proper time will be allowed for the completion and service tests prior to putting the cable in service.



## CABLE MAINTENANCE

Cable maintenance grows as a problem not only because of the amount concerned and the fact that much service is in the sheath but also because, as the cable ages, there is an accumulation of things all of which seem to operate in the direction of increasing causes of trouble. On underground cables the major trouble making factors are highway changes, subsurface operations of others, electrolysis, improper racking in manholes, heavy road vibration, interference by our own workmen, floods, etc. Similarly, on aerial cables the trouble making factors are bullet holes, tree interference, buckling and ring cuts, fires and electrical burns, etc.

The principal consideration in cable maintenance is to keep the sheath water tight. Constructive suggestions along the line of preventive maintenance are as follows:

For Underground Cables, more consideration to proper duct assignments, better set-ups and more careful racking in manholes, better contact with municipalities and highway contractors, education of employees designed to promote a more careful handling of cables in underground runs, suitable designations for toll cables, better electrolysis surveys particularly those which involve the maintenance of existing drainage connections in conduit and more frequent inspections of manholes.

For Aerial Cables, more frequent inspections, better contact with municipalities and highway contractors, splicing aerial cable under tension during construction and particularly straightening out of aerial cable before splicing, in order to eliminate irregularities which later develop into buckles and ring cuts, elimination of fire hazards and construction of new cables over routes which are free from fire hazards, cleaner and wider right-of-way.

## FIRE HAZARDS

The protection of aerial cables from fire in adjacent inflammable structures has been given much thought. Hazards have been eliminated by rerouting the line, by moving the hazard and by constructing underground dips. When these methods are not practicable and wherever there is a reasonable separation between the hazard and the cable, consideration has been given to protecting the cable and messenger with a fire resisting shield.

After many tests, a cylinder of asbestos shingle material, split longitudinally, is being tried out. The edges are butted by means of a copper strip of "H" cross-sections and the completed cylinder is bound with copper bands. Shields weigh from 7 to 10 lbs. per foot and require an additional messenger strand for support. We expect this arrangement to be satisfactory for small buildings twenty feet or more from the cable line.

## TROUBLE CLEARING

Trouble clearing is that phase of maintenance which deals with locating and repairing the cable sheath or conductors after the damage has been done. Testing apparatus and methods have been perfected to a point where they are very accurate in trouble locations. The new Wheatstone bridge, together with temperature correction curves and intensive training of testboard employees, all have done much to improve testing results.

New cables are being manufactured with one quad of enameled wire in order to assure a good wire for Varley measurements even though a cable may be saturated with water at a given point. Leak alarm circuits are being tried out placed in the outside layers and connected with alarm devices in central offices in order to assist testboards in detecting cable troubles in the early stages.

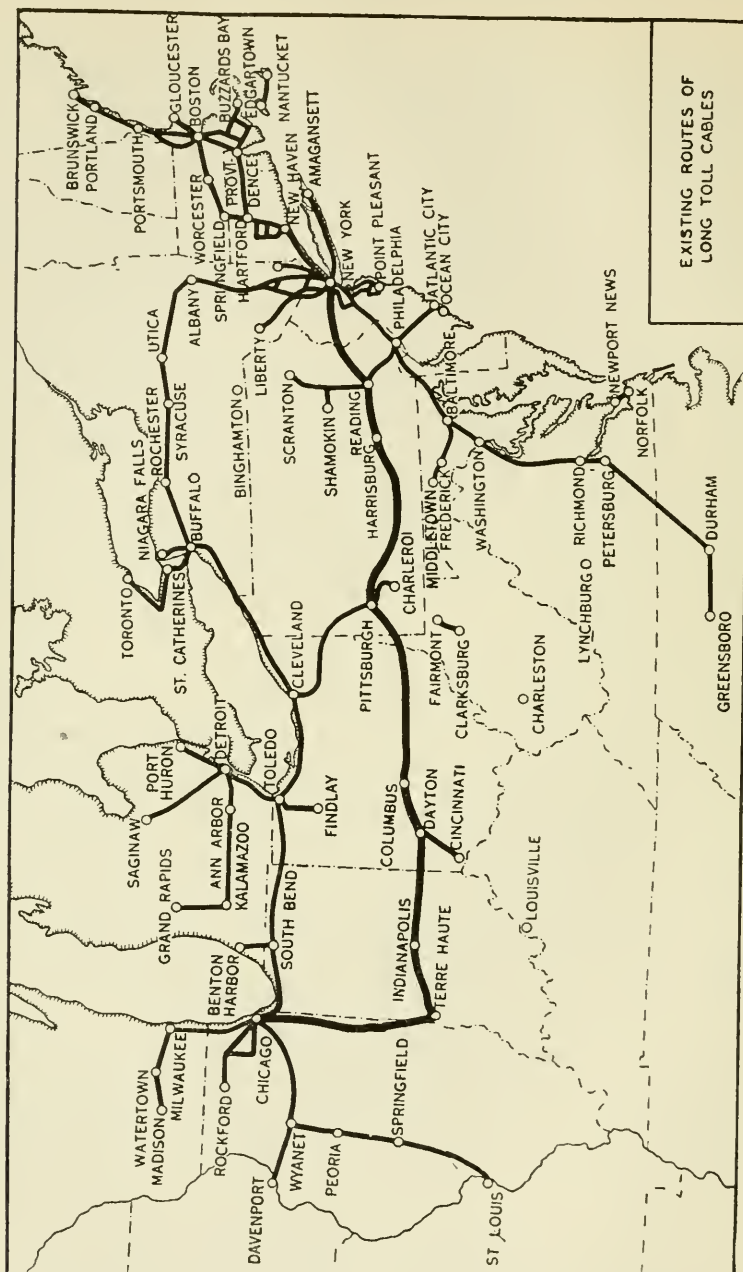
### PERMANENT GAS PRESSURE

The testing methods referred to above are based on locating sheath defects after moisture has entered the cable and grounded certain conductors. Thus impaired service is a prior condition to locating and clearing the trouble. In underground cables this is particularly serious since a trouble may not be detected or located until a cable has failed altogether. This brings us to the subject of permanent gas pressure on toll cables. Its effectiveness in avoiding service interruptions should not be interpreted to mean that it eliminates the need for preventive maintenance. Permanent gas pressure will not prevent sheath breaks. It does, however, enable us to locate and clear sheath breaks before service is affected. Therefore, it is important not to neglect the cable sheath merely because gas pressure gives us a means of locating sheath breaks before service is affected.

Briefly, the work which has been done to date in placing toll cables under permanent pressure, includes sealing the cable at both ends and at all lateral taps with beeswax plugs, installed without interrupting service. In addition to plugging the cable at the ends and at lateral taps, intermediate plugs are installed at approximately 10-mile intervals, in order to sectionalize the cable for use in locating sheath breaks. Tire valves are soldered into the sheath at approximately one-mile intervals. Gas is introduced at approximately 40 pounds pressure at each valve in the section. When equalized throughout the section the pressure is between 15 and 20 pounds. The cable is also equipped with alarm gauges which automatically indicate in adjacent test rooms any lowering of the pressure in any section of the cable.

### DRYING OUT WITH GAS

Another important advantage of the nitrogen gas in maintenance work is the drying property of the gas





admitted on either side of a cable which is wet. In several instances, we have avoided pulling in and cutting over a new section of cable. In many other instances we have practically restored complete telephone service within three or four hours after a failure. In these latter cases, the gas was applied and the drying out process continued up to the time when the duct was rodded, the new cable pulled in and the splicers were ready to cut over. The drying out process not only restored practically all of the telephone service, but materially aided the splicers in toning through the defective section when cutting over. We are reasonably certain that only those cases where the cable is slightly wet can be dried out completely with gas. Cases where the cable is thoroughly saturated with water must be handled in the usual manner—either replacing the section or cutting in a short piece of cable. The gas, however, is helpful in all cases in partially restoring service prior to the cutover and in aiding splicers in the actual work of cutting over.

L. N. STOSKOPF.

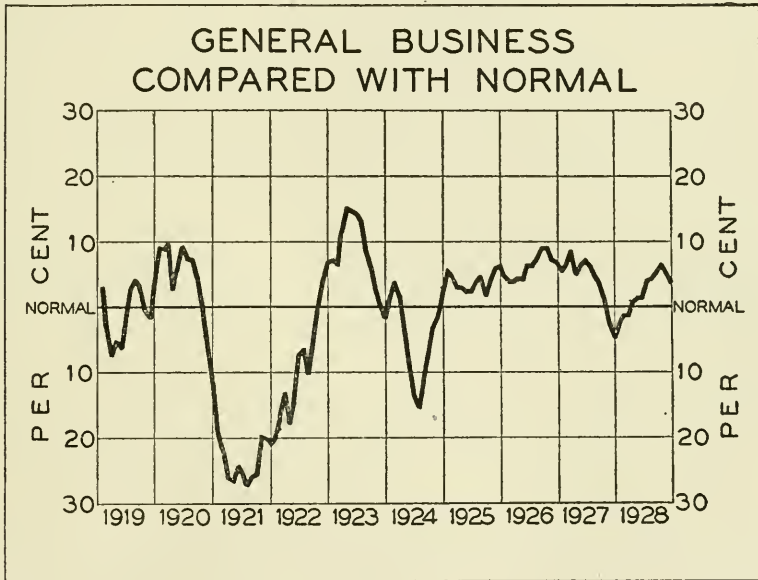
## An Index of General Business Activity

THE recent completion of a revision, for the period since January, 1919, of the index of general business activity in the United States, constructed by the Chief Statistician's Division of the American Telephone and Telegraph Company, furnishes a pertinent occasion for the brief discussion of that index, which is the subject of this article. The chart on the following page shows the revised index—frequently called a “general business curve”—for the decade 1919 to 1928, inclusive. While the revision of the index has not materially altered the appearance of the curve from its previous aspect, nevertheless since certain recently available industrial statistics and newly developed methods of statistical analysis were employed in the process of revision, it is felt that the new index has some distinct improvements over the former one as an indicator of the course of general business activity in the country as a whole.

As has been pointed out in previous articles in this QUARTERLY,<sup>1</sup> it has been found useful in the Bell System to have available a measure of fluctuations of business activity outside the telephone industry, as a basis for comparisons with fluctuations within the telephone business. This is so in spite of the fact that the telephone business as a whole is one of exceptional stability, relative to its long-term rate of growth, as compared with many classes of manufacturing and merchandising industries. Statistical analysis has indicated, however, that in certain phases of the telephone business there are fluctuations due to factors other than those reflected in long-term growth and seasonal characteristics, and that these fluctuations tend to synchronize with the so-called “cyclical” fluctuations in external busi-

<sup>1</sup> *The Statistical Study of General Business Conditions*, October, 1924; *Measures of Regional Business Activity*, April, 1928.

ness activity. It is clear, therefore, that a measure of general activity based on significant indices, sufficient in number to be relatively free from the peculiarities inherent in any single external index that might be selected, would be a substantial aid in interpreting fluctuations of such elements within the telephone business. Furthermore, not only would such an index be of service in evaluating past tendencies and in interpreting current performance, but it would also provide a basis whereby forecasts of general business activity might be expressed in quantitative terms and might therefore be more easily applied in the preparation of estimates of future telephone operations and results.



#### CHARACTER AND COMPOSITION OF THE INDEX

In the major cyclical movements of general industrial activity upward or downward, it is likely to be true that most important industries are moving in unison at least as to direction. There have, of course, always been certain industries or lines of business which at

any given time have moved counter to the general picture either because one man's meat is another man's poison, or because they tended to precede or to lag behind the general run of industries in their movements. Telephone traffic, however, as has been indicated, tends to move pretty much in step with the general average of industrial activity at any given time. It therefore seems clear that the general business index against which telephone movements would be compared, should be primarily an index which gives a reasonably good composite picture of fluctuations in external activity. This circumstance conditioned in no small measure the type of index to be constructed on the basis of such statistics as were available. The availability of statistics was naturally a major consideration. So, too, was the factor of relative sensitivity of the series to be included in the index. Given the fact that certain statistical processes can make due allowances, when necessary, for varying degrees of sensitivity, it is clear that the more sensitive the index, the more likely it is to call attention promptly and definitely to any real changes in the general business situation. An index representing largely basic production at or close to the raw material stage tends to be sensitive in its movements.

Obviously, for the early years covered by the general business index, the number of available statistical series which could be used as indicators of business activity in the United States was small. For the period from January, 1877, to December, 1884, indeed, the index is based solely on an analysis of the productive capacity of blast furnaces active at the beginning of each quarter of the year.<sup>2</sup> Beginning with January, 1885, monthly bank clearings outside of New York City were added to the composition of the curve, and in the same year figures on blast furnace capacity became available

<sup>2</sup> As indicated, the general business index extends back to 1877, although the accompanying chart shows the curve only over the period involved in its latest revision. The monthly points of the index since 1877 are given in the table at the end of this article.



monthly instead of quarterly. For the eleven years ending in 1902, the curve had three components: blast furnace capacity, bank clearings, and Bradstreet's monthly index of wholesale prices. Later on other series of data were added, and certain ones were dropped from time to time. Among these were pig iron production, gross operating revenues of railroads, net surplusages or shortages of freight cars, copper production, revenue freight car loadings, net ton miles of freight carried by Class I railroads, bituminous coal production, steel ingot output, electric power production, lumber production, consumption of raw cotton by textile mills, etc.

Prior to the recent revision of the index, the composite curve for the period since October, 1923, included eleven series of figures. No series involving dollar totals or prices were employed during that period; all the components of the index being series representing volume of activity measured in physical units, such as tons of coal, or bales of cotton, or cars loaded with freight. All but three of the series represented activity in basic industries at or close to the raw material stage, the three exceptions being two railroad series and monthly statistics of electric power production. These three last named series are still found in the revised curve, which, in addition, includes ten strictly industrial series, all of the same general character as the eight previously used.

The latest revision of the general business index was undertaken in order to provide a consistent set of component items for the period since the beginning of 1919 and to incorporate revised seasonal factors and trends wherever necessary. As a result of a thorough review of available industrial statistics, and of the significance of these statistics for the fundamental purpose of the index, series of statistics representing the following items were selected: cotton consumption, woolen machine hours active, pig iron production, steel ingot pro-

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duction, lumber production, sole leather production, gasoline production, bituminous coal production, copper production, zinc production, electric power production, freight car loadings, and net freight ton miles. Many other series were considered in this review, but were discarded for one reason or another. Moreover, experiments have shown that the inclusion of additional series of similar character would not perceptibly affect the movements of the composite curve based upon the 13 series above mentioned.

## AMERICAN TELEPHONE AND TELEGRAPH COMPANY GENERAL BUSINESS CURVE

(Expressed in terms of percentage deviations from normal)

|         | 1877 | 1878 | 1879 | 1880 | 1881 | 1882 | 1883 | 1884 | 1885 | 1886 | 1887 | 1888 | 1889 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan...  | - 9  | - 8  | -13  | + 7  | +12  | +11  | + 9  | -10  | -16* | -10  | - 2  | - 2  | + 6  |
| Feb...  | - 9  | - 9  | -13  | + 9  | +12  | +11  | + 7  | - 9  | -19  | - 8  | + 3  | - 2  | + 5  |
| Mar...  | -10  | -10  | -13  | +11  | +12  | +12  | + 4  | - 8  | -17  | - 6  | + 9  | - 7  | + 3  |
| Apr...  | -11  | -11  | -13  | +12  | +12  | +12  | + 2  | - 8  | -16  | - 8  | + 8  | - 6  | + 1  |
| May...  | -10  | -11  | -11  | +10  | +12  | +10  | + 2  | - 7  | -19  | - 7  | + 8  | - 2  | + 4  |
| June... | - 8  | -12  | - 9  | + 8  | +13  | + 8  | + 1  | - 6  | -14  | + 3  | + 6  | - 2  | + 2  |
| July... | - 7  | -12  | - 7  | + 7  | +13  | + 5  | + 1  | - 6  | -11  | + 4  | - 2  | - 3  | + 7  |
| Aug...  | - 7  | -12  | - 3  | + 7  | +13  | + 7  | + 1  | - 8  | -15  | + 2  | + 2  | + 2  | + 6  |
| Sept... | - 7  | -12  | + 2  | + 7  | +12  | + 9  | + 2  | -10  | -14  | + 2  | + 7  | + 2  | + 1  |
| Oct...  | - 7  | -12  | + 6  | + 7  | +12  | +10  | + 2  | -12  | -12  | + 1  | + 5  | + 8  | + 8  |
| Nov...  | - 7  | -12  | + 6  | + 9  | +12  | +10  | - 2  | -15  | -11  | + 2  | + 7  | + 2  | + 7  |
| Dec...  | - 8  | -13  | + 7  | +11  | +11  | + 9  | - 6  | -18  | - 9  | + 3  | + 1  | + 3  | + 5  |
| Av....  | - 8  | -11  | - 5  | + 9  | +12  | +10  | + 2  | -10  | -14  | - 2  | + 4  | - 1  | + 5  |

|         | 1890 | 1891 | 1892 | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | 1900 | 1901 | 1902 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan...  | +11  | + 5  | + 9* | +12  | -14  | - 3  | - 1  | -13  | - 3  | + 1  | +10  | - 1  | + 2  |
| Feb...  | + 8  | + 1  | +14  | +12  | -16  | - 9  | - 2  | -11  | - 2  | + 1  | +11  | 0    | + 2  |
| Mar...  | +10  | - 5  | +11  | +12  | -14  | -10  | - 7  | -12  | - 3  | + 4  | +10  | + 2  | + 2  |
| Apr...  | +12  | - 6  | + 9  | +11  | -14  | -11  | - 5  | -12  | - 7  | + 1  | + 8  | + 5  | + 5  |
| May...  | +17  | - 7  | + 7  | +11  | -14  | - 8  | - 8  | -15  | - 7  | + 2  | + 6  | + 4  | + 5  |
| June... | +15  | 0    | + 9  | + 5  | -20  | - 6  | - 8  | -13  | - 4  | + 3  | + 6  | + 3  | + 2  |
| July... | +16  | + 8  | + 6  | - 2  | -18  | - 1  | - 8  | -14  | - 8  | + 3  | + 3  | + 4  | + 4  |
| Aug...  | +12  | + 7  | + 6  | -13  | -10  | 0    | -14  | -10  | - 5  | + 6  | 0    | + 4  | + 3  |
| Sept... | +15  | +13  | + 7  | -17  | - 7  | + 1  | -16  | - 3  | - 5  | + 8  | - 3  | 0    | + 6  |
| Oct...  | +17  | +12  | + 8  | -17  | - 7  | + 6  | -17  | - 4  | - 7  | + 9  | - 3  | + 3  | + 5  |
| Nov...  | + 8  | + 7  | +10  | -16  | - 6  | + 4  | -16  | - 4  | - 4  | + 8  | - 4  | + 2  | + 2  |
| Dec...  | + 5  | + 7  | +12  | -15  | - 4  | + 3  | -13  | - 2  | - 2  | +11  | - 4  | + 1  | + 3  |
| Av....  | +12  | + 4  | + 9  | - 1  | -12  | - 3  | -10  | - 9  | - 5  | + 5  | + 3  | + 2  | + 3  |

# An Index of General Business Activity

## STATISTICAL PROCESSES

Before the series are combined into the general composite index, each series is adjusted for its own seasonal variation and its computed long-time trend, with the further refinement for the years subsequent to 1919 that, where appropriate, the monthly data have first been reduced to a daily average basis before adjustment for seasonal factors, in order to eliminate all changes due merely to calendar shifts. After seasonal and trend adjustments have been made, the monthly data have been expressed as percentage deviations from the

### AMERICAN TELEPHONE AND TELEGRAPH COMPANY GENERAL BUSINESS CURVE

(Expressed in terms of percentage deviations from normal)

|         | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan...  | + 3* | -10  | - 5  | +10  | +17  | -14  | - 5* | +12  | 0    | - 2  | +10* | 0    | -16  |
| Feb...  | + 1  | - 5  | - 5  | + 9  | +14  | -15  | - 5  | +10  | - 1  | + 3  | + 8  | - 2  | -13  |
| Mar...  | + 2  | - 8  | - 2  | + 7  | +15  | -15  | - 5  | +12  | 0    | + 3  | + 3  | 0    | -12  |
| Apr...  | + 4  | - 6  | - 1  | + 5  | +16  | -14  | - 5  | +11  | - 3  | + 6  | + 5  | - 1  | - 9  |
| May...  | + 3  | - 8  | 0    | + 8  | +18  | -17  | - 3  | + 6  | - 2  | + 5  | + 5  | - 5  | - 8  |
| June... | + 2  | -10  | 0    | + 7  | +16  | -17  | - 2  | + 7  | - 1  | + 3  | + 4  | - 4  | - 4  |
| July... | + 3  | -12  | - 1  | + 7  | +18  | -16  | + 1  | + 4  | - 2  | + 5  | + 5  | - 2  | - 3  |
| Aug...  | - 1  | -12  | 0    | + 8  | +16  | -13  | + 2  | + 4  | - 1  | + 6  | + 2  | - 8  | - 2  |
| Sept... | - 2  | - 8  | + 2  | + 5  | +12  | -11  | + 5  | + 4  | - 1  | + 5  | + 3  | -10  | + 2  |
| Oct...  | - 6  | - 9  | + 2  | +10  | +13  | -11  | + 8  | + 4  | - 1  | + 8  | + 5  | -13  | + 5  |
| Nov...  | -11  | - 4  | + 4  | +11  | - 4  | - 9  | + 9  | + 2  | - 1  | + 7  | - 1  | -17  | + 9  |
| Dec...  | -14  | - 5  | + 7  | +13  | -12  | - 8  | +10  | + 1  | - 2  | + 7  | - 2  | -18  | +14  |
| Av....  | - 1  | - 8  | 0    | + 8  | +12  | -13  | + 1  | + 6  | - 1  | + 5  | + 4  | - 7  | - 3  |

|         | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan...  | +11  | +17  | + 4  | + 3* | + 9* | -19  | -20  | + 7  | + 1  | + 5  | + 5  | + 5  | - 3  |
| Feb...  | +12  | +13  | + 3  | - 3  | + 9  | -22  | -17  | + 6  | + 4  | + 5  | + 4  | + 6  | - 2  |
| Mar...  | +13  | +14  | +10  | - 8  | +10  | -26  | -13  | +11  | + 2  | + 3  | + 4  | + 8  | - 1  |
| Apr...  | + 9  | +12  | +10  | - 5  | + 3  | -27  | -18  | +15  | - 3  | + 3  | + 4  | + 5  | 0    |
| May...  | +12  | +14  | +13  | - 6  | + 7  | -24  | -14  | +15  | - 9  | + 2  | + 4  | + 6  | + 1  |
| June... | +11  | +12  | +10  | - 2  | + 9  | -26  | - 8  | +14  | -14  | + 2  | + 6  | + 7  | + 1  |
| July... | + 8  | +10  | +14  | + 3  | + 8  | -27  | - 6  | +13  | -15  | + 3  | + 6  | + 6  | + 4  |
| Aug...  | +12  | +10  | +15  | + 4  | + 7  | -26  | -10  | + 9  | -11  | + 4  | + 7  | + 5  | + 4  |
| Sept... | +13  | + 7  | +11  | + 3  | + 5  | -25  | - 5  | + 6  | - 7  | + 2  | + 9  | + 3  | + 5  |
| Oct...  | +15  | + 9  | +10  | - 1  | + 1  | -20  | - 1  | + 3  | - 3  | + 4  | + 9  | 0    | + 6  |
| Nov...  | +17  | +11  | + 5  | - 2  | - 6  | -20  | + 4  | + 1  | - 2  | + 6  | + 7  | - 3  | + 5  |
| Dec...  | +16  | + 6  | + 6  | + 3  | -12  | -21  | + 7  | - 2  | + 2  | + 6  | + 7  | - 5  | + 3  |
| Av....  | +12  | +11  | + 9  | - 1  | + 4  | -24  | - 8  | + 8  | - 5  | + 4  | + 6  | + 4  | + 2  |

\* Denotes months in which composition of curve changes.

calculated normal or seasonally adjusted trend. These percentage deviations then represent in each case those fluctuations found in the series in question, which, however they may be explained, are presumably not due to the factor of trend, on the one hand, or to seasonal changes, on the other. That is to say, they show the "business cycle" and other non-recurrent (or so-called "accidental") fluctuations in the series, which are the movements which the curve seeks to measure. Each series has then been expressed in terms of its standard deviation, and the composite represents a weighted average of the series so expressed.

The determination of the weights which were assigned to the individual series was based upon a number of economic and statistical considerations, of which the principal one is the relative degree of representativeness of the general picture which was believed to inhere in each series. The iron and steel series reflect not merely conditions in the steel industry itself, but also in the principal industries consuming steel, such as the automobile, railroad equipment, building and oil industries. The railroad series and electric power production naturally reflect all types of industrial activity. The railroad series in addition also reflect distribution. And so on through the list, the several series reflect in varying proportions not only their own inherent activity and contribution to the country's industrial life, but also the activity of other industries which consume the products and services of those industries directly represented in the index.

It is easy to overemphasize the influence of the weighting given to component items on the movements of a composite index of general business. It is obvious, however, that a reasonable system of weights, applied to a fair sample of series of data reflecting general business or industrial activity, should help that sample to represent all the better the general economic picture which it aims to portray. That a reasonable system of



weights has been applied in the present case would seem to be indicated by the fact that the revised general business index, although containing only thirteen series, moves in close consonance with certain other indexes comprised of a much larger number of components, such as, for example, the index of industrial production of the Federal Reserve Board.

Undoubtedly this general business index, as well as other general indexes of business activity, may be subject to occasional criticism, particularly by persons outside the telephone industry. On this point, however, it is always well to remember that the index described herein has been constructed primarily for use where applicable in connection with factors within the telephone business. It does not seek to measure the actual amplitude of cyclical fluctuations in all branches of economic activity, but it is merely designed to reflect, in a sensitive way, certain of the external movements which are helpful in studies of the telephone business. If it accomplishes this aim, it serves the purpose for which it is intended.

The two preceding tables show to the nearest per cent. the monthly points on the curve for the 52 years from 1877 through 1928. Each of these points represents the percentage deviation of the index from "normal."

PAUL J. WEBER.

*Editor's Note:* Mr. Weber is of the Chief Statistician's Division of the American Telephone and Telegraph Company.

## Standardization in the Bell System—II

### *Introductory Note*

IN the January 1929 issue of the Bell Telephone Quarterly appeared the first part of a paper on "Standardization in the Bell System" prepared in response to a request from the National Industrial Conference Board. A more complete statement regarding the preparation of this paper was given in an introductory note to the first part.

The second and concluding part of this paper is given below.

THE EDITORS.

### STANDARDIZATION OF MANUFACTURING PLANT, EQUIPMENT AND PROCESSES

In the Manufacturing Department standardization of manufacturing processes is closely related to standardization of the factory buildings themselves, their fixtures, such as heating and ventilating systems, and general manufacturing equipment. The cost of designing and erecting structures whether required in new locations or as additions to existing plant facilities has been reduced to a minimum by predetermining building unit designs adapted to specific manufacturing requirements, the units being increased in number as requirements demand.

Many years ago a standard building width was adopted which made possible an economizing of building space permitting the use of machinery, benches, racks, etc., with dimensions most suitable for installation in the building. The productivity of a fixed investment in buildings has been increased, and an important economy in the cost of installation of their equipment has been realized.

In the design of buildings for the new manufacturing plant at Kearny, New Jersey, a uniform column spacing is maintained throughout all multi-story buildings. A great many advantages relating to occupancy have been realized from this standardization. An example is a reduction in cost of approximately 50 per cent in constructing and erecting metal partitions. Uniform column spacing made it possible to design partition panels of a standard width which is an even fraction of the spacing of columns. This eliminated the necessity of making drawings of each partition installed, as it is sufficient to indicate on the standard floor plans the position of each panel. The cost of constructing and erecting partitions has been reduced by increasing the proportion of construction work which may be performed in the machine shop in larger lots and by economical methods and suitable equipment, rather than in the field where adequate facilities are not available.

It is the responsibility of one organization within the Manufacturing Department to see that all new machinery is in accordance with established standards, or to recommend new standards for new conditions. In some specific cases where another type of machine will be more economical for some heavy running part, it is desirable to depart from these standards. There are many advantages incident to having a standard type machine for each class of work: lower first cost because of volume buying, ease in applying standard safety measures, adaptability to standardized processes, adaptability for use with standardized associated equipment, such as benches and trucks, flexibility of the machine equipment to meet peak loads and interchangeability of machine parts, which reduces the cost of maintenance.

Not only the machines themselves but their associated parts, such as bearings, clutches, hand wheels, control levers, mountings for electrical apparatus and lub-

rication systems, are standardized. As far as possible these standards are applied to the machines purchased as well as to those made in the shops.

Manufacturing fixtures such as shop benches, lockers, racks, trunks, etc. have been standardized and the advantages of such standardization appear daily in the manufacturing work. In preparing arrangements of office and shop departments, as the dimensions of each item to be installed is known in advance its position may be fixed without requiring its measurement in each instance. This not only reduces the cost of fitting manufacturing equipment in the space allotted to it, but also makes possible floor space conservation by the best arrangement of equipment, and important economies later in its operation by providing for the convenience of the workmen. Standardization of these items has had the usual effect of reducing the cost of their manufacture by making possible quantity production of a small number of items, rather than small quantity manufacture of a large number of items.

Considerable benefit has been derived from the standardization of tools and gauges and design practices. Standard and typical drawings have been made for various types of punches and dies, drill jigs, fixtures, and other classes of tools. Parts such as drill bushings, latches, gauge pins, jig feet, clamping cams, punch and die holers, line guide and dowel pins, stops, springs, die blanks, etc., have been standardized. Many of the different sizes of these parts have been replaced by common sizes reducing the sizes stocked to a small percent of the original. This and standardization of design greatly reduced the raw materials necessary to be carried, and in most cases replaced the practice of making parts as required for each tool by the more economical one of producing these parts in quantity lots of few types, to be stocked and drawn for use as required.

Tool steels have been classified and assigned code numbers, and a table lists the proper steels to be used



for standard and common types of tools and parts. Tools and parts purchased from suppliers have been standardized and stocked to avoid duplication, insure interchangeability, facilitate replacement and repair, and secure the advantage of quantity purchasing.

Standardization has simplified and reduced the cost of design work, and has also secured better uniformity and more economy of design, considering manufacture, operation and maintenance. It has permitted the manufacture of standard parts on a quantity production basis with its resulting economy, and due to the selection of available standard designs has facilitated the adoption of standard methods in building of tools to reduce their cost.

As an example of the results of standardization in tool making, when an open compound punch and die of a relatively common type is required, the only design work necessary is to lay out the special die form and to specify by code number the standard parts to be drawn from stock to be assembled in the tool. The majority of these are usually available. The special parts will be made and assembled with the stock items to complete the tool. It is estimated that a tool made by these standards will result in a saving of one third on the average over the cost of producing the same tool by making drawings of each part individually and producing all of the parts at the time the tool was built. This percentage will, of course, vary considerably depending on the type and complexity of the tool and the extent to which standards may be applied.

The manufacturing processes for all material made in large quantities in the Western Electric Company are covered by operating instructions or "manufacturing layouts." A Planning organization originates these manufacturing layouts, directing the employment of processes and equipment that have been carefully standardized to give the highest quality of product and to be most economical of time and material.

Many of the processes that are specified in the manufacturing layouts are covered by process standards. This enables the planning organization merely to specify the proper standard, without going into the detailed description of the process to be followed. For example, wood finishes are covered by standards that specify all of the materials to be used, such as varnishes, shellacs, sandpapers, and rubbing compounds, and give the drying periods. These standards are accompanied by samples of the finish that is to be matched.

Another example is found in the standardization of methods to be used in the carrying out of chemical processes, such as electroplating. In this case the process standard specifies the density of the electrolyte, the temperature, the current intensity, etc.

Heat treating processes are similarly covered by standards so that when a new product is to be made, it is merely necessary to specify the standard in accordance with which it is to be heat treated.

The use of standards of this kind not only simplifies the work of making the manufacturing layouts, but it also simplifies the introduction of the manufacture of new products in the Shop, as the operating people are already acquainted with these standard processes and have the necessary materials and equipment already available.

#### STANDARDIZATION IN DISTRIBUTION AND INSTALLATION

In distributing and installing apparatus and equipment, the standardization of methods, tools and materials is also of great importance.

When the thousands of orders transmitted to the Electric Company for execution and the large number of sources from which these originate are considered the value of standardized methods of ordering is apparent. Standard requisition forms originating with the telephone companies convey the orders, along with necessary shipping instructions, to the distributing

houses of the manufacturer. To facilitate the handling of orders for complicated assemblies of equipment, such as complete central office equipments or large long distance offices, a series of ordering questionnaires has been developed. These questionnaires accompanied by necessary building plans and other drawings provide in an orderly sequence all the data necessary to acquaint the equipment engineers with the detailed requirements of the project; they are designed to suggest the use of standard equipment and arrangements wherever possible.

When such an order requiring engineering work by the Western Electric Company reaches one of its factories, the Equipment Engineering Department translates the telephone companies' requirements into manufacturing specifications and drawings utilizing standard equipment specifications and drawings on eighty to ninety percent of all orders for central office equipment units, such as switchboards, desks, and the mechanical units for dial offices. This results in standardizing the information which goes to the Manufacturing, Installing, and Pricing Departments, and minimizes the effort required to engineer, manufacture, test, install and price the equipment.

Even when supplementary equipment is required to meet certain local conditions and is not suitable for standardization the method of preparing the manufacturing specifications is standardized through the use of standard equipment engineering specification forms, which list the standard editing information for a particular unit of equipment and leave the quantities to be filled in by the engineers. This not only reduces the engineering effort, but also maintains uniformity in arrangement and sequence of the information in the specifications thereby adding greatly to the convenience with which such specifications may be used by other organizations.

An important advantage of equipment standardiza-

tion is that it permits the resultant standardized units to be stocked or otherwise made available on a short delivery basis.

By stocking standard units the delivery intervals on certain types of central office and private branch exchange equipment have been greatly reduced in the past few years. For example, the delivery interval for certain private branch exchange equipments was reduced from six months to one month. Furthermore a great many special features have been dispensed with which were formerly thought necessary when equipment was ordered on a custom built basis, and because of the much smaller variety, production authorizations may now be placed on the Manufacturing Departments in larger quantities or on an even flow basis so that progressive assembly methods may be applied which result in lower overall engineering and manufacturing costs.

As an aid in establishing and maintaining standard equipment designs and in giving such standards necessary publicity with the telephone companies, the manufacturer's standard specifications, stock lists, catalogs, and price lists are published and distributed to the customers.

These plans do not retard the work of the development engineers in effecting improvements in design. Improvements and changes, however, are made on an annual basis unless the advantage of the improvement makes it expedient to introduce it at once. This facilitates the introduction of new designs and minimizes the effect on stocks and schedules.

In the case of central office and toll equipment especially, it is usually the function of the Western Electric Company to erect or install the equipment and to deliver it to the customer as a complete operating unit. Standard methods for planning, estimating and performing the installation work have been established and are prescribed for the guidance of installation crews working in all parts of the country. All necessary



tools, fixtures, gauges, and testing devices are covered by standard designs, and these standards are specified for use wherever they apply. Such things as scaffolding, temporary lighting, storerooms and job office equipment are also standardized.

The standardization of apparatus greatly facilitates the standardization of packing methods and shipping containers.

The thousands of different items which must be packed and shipped by the Western Electric Company makes the packing problem an extremely important one. In developing standards of packing consideration has to be given not only to the first cost of containers and packing material but also to the serviceability of the package from the standpoint of withstanding abuse in transit, to the convenience with which it may be handled and stored in the Western Electric Company's warehouses and in the Telephone Companies' storerooms, and even, in the case of subscriber's station equipment, to the convenience with which the package may be finally distributed to the subscriber's premises.

When a new method of packing, or a new type of container has proved to be better for a certain item than an existing method, or container, its application to other items is immediately considered; however every effort is made to keep the variety of sizes and shapes of containers at a reasonable minimum.

To assure uniform methods where products are packed at more than one location and to preserve the standard designs, specifications and drawings covering the method and designs are prepared and accumulated in a packing manual.

Standard methods instructions are distributed to the installers in the form of handbooks. Catalogs of standard tools and supplies, giving information as to how and where each item may be obtained are also supplied to the men. The sequence in which apparatus and material can best be used by the installers has been

studied and standard shipping schedules are prescribed to insure that the work may proceed in an orderly manner.

Before a completed equipment is turned over to the telephone company certain standard final tests are applied by the installers to assure its satisfactory performance. This insures that a certain circuit will be tested in the same manner and must meet the same requirements whether installed in New York or on the Pacific Coast.

The procedure and methods for making tests and the testing equipment have been standardized to conform to the standard tests. A number of standard sizes and types of test set containers have also been adopted.

#### STANDARDIZATION IN RELATION TO OPERATION

As a part of the work of the General Departments, the best methods for the construction of telephone plant are worked out, taking account of the experience of all of the Operating Companies. These methods are presented in the form of construction handbooks, which are made available to all of the operating companies through a common source in order to get the advantage of quantity production.

The standard construction practices are based upon the use all over the country of standard types of construction material. This standardization of materials makes it possible for the purchasing organization to buy very large quantities of a relatively small number of types of material with resultant large savings in cost. Also with shifting of needs men engaged in construction work can transfer easily from one part of the System to another. It is common practice, in cases of emergency due to large storm damage or other causes, to temporarily concentrate in one small area construction gangs from a number of different operating companies. These men have no difficulty with the work

in a new area because of the uniform construction practices in use throughout the country. Furthermore, in severe storm emergencies the fact that the material needed has been standardized makes it possible to obtain it quickly in great quantities from the many points where it is stocked throughout the country.

The maintenance practices are standardized in ways similar to those discussed for the construction practices. Bell System maintenance practices are prepared by the general departments, making use of the maintenance experiences of the operating companies and of general investigations of the relative advantages of different practices and methods. These standard practices are printed in quantity and are ordered by the various companies for use as required. In addition to the advantages discussed above for uniform construction practices, there is a further advantage, important from the standpoint of toll service, that men at widely separated points and employed by different companies are using the same practices for the maintenance of telephone circuits and equipment. These men can, therefore, deal with each other at long range effectively without misunderstanding because of their common background of methods and materials.

It is perhaps in considering traffic operating practices that the advantages, and indeed, the necessity of standardization in relation to operation, are most evident in the Bell System. The telephone subscriber has the right to expect the same sort of operating practices in the various cities of the country so that he may use the telephone with a maximum of convenience. In toll calls the operators must constantly deal with other operators in distant cities and employed by different companies, and it is obviously essential that the operating practices should be alike in order to avoid difficulties.

Standard operating practices are developed by the general departments as a result of their studies and investigations, and taking advantage also of the actual

operating experience of the companies. These standard operating practices are used for handling all types of calls with the various types of standard equipment. The practices cover local exchange service in all of its forms, such as flat rate, message rate, coin box, individual or party line service, etc., and also toll and long distance service. They also cover information service and other auxiliary services for calls requiring special treatment.

The practices specify in detail the procedure to be followed by operators in handling these various types of calls, and in general specify also the phraseology to be used by the operators, with a view to insuring maximum accuracy, clearness and convenience to the subscribers.

As operators are constantly entering and leaving the service, it is necessary to carry on continuously schools for the training of new operators. Each Associated Company maintains a Training Department and the methods and equipment used in this training work have been standardized throughout the entire country.

An interesting illustration of the standardization of operating practices is given by the procedure known as the "Service Order Routine" for establishing new or changing existing telephone service. These operations require the co-ordinated effort of all operating departments of the telephone company, including arrangements for installing subscribers' station apparatus and wiring, the placing of outside wires, the inter-connection of apparatus in the telephone central offices and proper designation of the new line at the telephone switchboard, proper tests of completed circuits, arrangements for commencing the furnishing of the traffic service and arrangements for proper billing and entry in the directory and for the advice of information operators. Extensive studies have developed general plans for accomplishing this somewhat complicated service function in the best possible way in a minimum



of time and with maximum insurance that all the necessary steps will be taken without confusion. On the basis of these general plans each operating company develops a specific detailed Service Order Routine which is made standard for that company.

#### STANDARDIZATION OF BUSINESS METHODS

A very valuable type of standardization which may be classed under the heading of "business methods" is the standardization of non-technical supplies, particularly of office supplies and furniture. Purchases of the Bell System companies in this line exceed \$5,000,000 per year and appreciable savings have been derived by the standardization of these supplies. In addition to the savings, such standardization has resulted in the provision of supplies better suited to company requirements through the analysis by trained specialists, in the determination of the best methods of handling supplies to promote efficiency and reduce waste, and in supervision of the quality of the supplies purchased.

The effect in reduction of costs can be illustrated by the single item of black lead pencils, the purchase of which amounts at the present time to more than \$150,000 a year. Prior to standardization fifty-five different brands were in actual use, while at the present time only three types are used, these providing a range of quality, with one of these grades covering 93 percent of all requirements. The saving from standardization of black lead pencils is estimated at \$50,000 per year.

Another interesting phase of this work has been the investigation of all clerical labor saving machines, the development of machines best adapted to the needs of the telephone business, and the standardization and use of the types found most advantageous.

In a business as complicated and as widespread geographically as the Bell Telephone System it is highly essential, in order that System reports may reflect accurately the results throughout the country, that a uni-

form classification of accounts be followed throughout. The accounts of the telephone companies in the Bell System have been standardized in accordance with those prescribed by the Interstate Commerce Commission, with certain amplifications which render them more effective for Bell telephone accounting practice and do not impair the integrity of the accounts prescribed. This makes it possible not only to summarize the growth and operation of the System as a whole but also to make significant comparisons of the results achieved by the various operating areas. Without such a system of uniform accounting, the unified and economical operation of the Bell System operating properties would be very greatly hampered.

Accounting practices and methods are studied continuously by specialists in the General Staff organization and improvements in standards which are developed are generally adopted by all the operating companies. Included in the detailed accounting practices which are generally standardized for the Bell System are such items as cost accounting, payroll and voucherizing methods, administrative reports and budgetary control methods, inventory control methods and schedules, auditing methods, application of mechanical devices to accounting work, and many other similar matters which lend themselves to standardization resulting in increased economies and efficiency.

One of the routine accounting jobs which lends itself to standardization is that of keeping the accounts of customers and rendering bills for service. The value of standardization for this routine work is readily seen in that in the Bell System, accounts are kept with approximately 11,000,000 customers and more than 125,000,000 bills for exchange service are rendered each year. More than one billion and a quarter charge tickets are handled annually in order that charges for service may be properly made against telephone users. Nine hundred million of these charge tickets are for

toll service, of which 750,000,000 must be entered separately on approximately 71,000,000 toll service statements.

For the keeping of accounts there has been developed and made standard what is known as the "accounting stub plan." In this plan, stubs which form a part of the bills are detached when bills are mailed and take the place of ledger or card records of the accounts.

For many years the preparation of bills and statements as to name, address and exchange service charges has been facilitated by the use of standard addressing equipment.

Rendering such a vast number of bills on a monthly basis brought about a very uneven distribution of work with a peak load at the beginning of each month, and to overcome this difficulty what is known as 'rotation billing' was introduced. Under this plan each accounting office divides its accounts into six groups and for each group bills are rendered at different dates at five-day intervals during the month. This permits of spreading the load over the entire month.

Along with the improvements in the practices referred to there has been a continuous development of machinery and other labor saving devices in connection with rendering customers' bills. To enter 750,000,000 toll charge tickets on approximately 71,000,000 toll service statements presented a most fertile field for the realization of economy through the development and standardization of mechanical devices. A standard form of statement for toll billing was developed and studies were made in conjunction with leading manufacturers of typewriters for devising a billing machine of special construction adapted to this particular work. After the machine was developed and exhaustively tested under careful observation it was made standard for Bell System use and has been adopted by all of the companies.

The standardization of practices, particularly the two referred to as "accounting stub plan" and "rotation billing plan," has made possible and practicable the standardization of specially constructed mechanical equipment (in addition to the toll billing typewriter referred to above) for the preparation of customers' bills which has been recommended for Bell System use. This equipment eliminates all handwriting from customers' bills and produces a more accurate bill than was possible under any other plan together with improved general appearance of bills. None of these standardized billing practices imposes unnecessary restrictions or complications upon the employees in the handling of business affairs with customers. Exception practices are provided so that the wishes of a customer desiring to be billed in a manner different from the standard or at other than prescribed billing periods may be given due consideration.

Telephone directories have offered an important field for standardization in spite of the fact that no two directories are entirely alike. The paper and cover stock used are standardized and purchased centrally through the Western Electric Company and manufactured in accordance with specifications and the supply checked continuously for quality. The general arrangement of material in the book is standard, standard alphabeting rules are followed in listing names, standard page sizes used, standard sizes of space offered for advertising and standard types used in printing. In the clerical work of compilation, standard practices are followed. From this standardization have resulted not only a uniformity in appearance and ease of reference, but large economies in compilation and manufacturing cost. It is estimated that without the standardization of directory paper and the bulk purchasing which this enables, the same quality of paper would cost the Bell System about \$800,000 more per year.



## STANDARD PROVISIONS FOR SAFETY AND HEALTH

The plant of the Bell System is constructed to conform to definite standards as regards strength of construction. In the formulation of these standards, consideration is given to the safety of the employees and the public, as well as to the continuity of service.

The question of safety is most important in cases where other wire lines or railroads also are involved. Standard requirements regarding type and strength of construction have been established for all such cases in co-operation with the other utilities involved. Many of these requirements are set forth in the National Electrical Safety Code. Experience shows that such construction standards greatly increase the safety of workers on telephone lines.

Safety is considered not only in the initial construction but also in the standard provisions for routine maintenance which call for maintaining suitable margins of strength in plant which is in proximity to other wire lines.

Very definite provisions have been made for protecting the public, the employees and property against electrical hazards. As a result of co-operation between the power and telephone companies standard provisions have been adopted to reduce the chance of power voltages or currents being introduced into any part of the telephone plant. These rules specify standards of strength and of separation, and the relative location of pole lines, wires and outside equipment when placed on the same poles, or in proximity.

Supplementing these precautions as regards power circuits, and as a provision against damage due to lightning, standard installations of protective apparatus are provided for subscribers' and central office equipment and for cables when the wires are exposed to these hazards. The use of standard arrangements throughout the country insures a uniform, high degree of safety to the users of the telephone plant.

Protection against fire is, of course, a very important consideration, particularly in the planning of buildings. Next to the safety of personnel, continuity of service is a main objective. All telephone buildings, except for certain small offices, are made fire resistive, the construction conforming to the standards of the National Board of Fire Underwriters for fire resistive buildings. The most approved fire resistive devices are used, such as metal and wire glass windows, hollow steel doors, extra strong partitions enclosing shafts and exits, and rolling steel shutters for openings facing hazardous exposures. In addition, very complete fire fighting appliances are provided in all buildings. Additional methods and devices are adopted by the companies in accordance with the recommendations of the Underwriters and as the result of investigations carried out by the headquarters' departments.

Standard equipment has been developed for both outside construction forces and manufacturing forces with a view to safety as well as efficiency. These developments include such things as linemen's safety straps, standard goggles for protection from dust and others for protection from heat, etc.

In the factories, standardized methods of safeguarding machines have been adopted that make it simple to guard new equipment and furnish a criterion for determining whether or not equipment is properly guarded. Because these standards have been tried in other installations, it can be confidently concluded that guards made in accordance with their requirements will not fail to afford maximum protection. Without such standards it would be necessary to design guards individually for each installation with the danger that the use of untried designs might result in unforeseen accident hazards. Standardized practices are followed in the provision of ventilators and dust removing devices, resulting in assured safety to the workers and in reduced cost of design.

A great deal of attention has been given to the development of standard safety provisions for the outside construction forces. In this standardization, groups of construction employees directly involved play an outstanding part. This procedure has the great advantage of developing the initiative and judgment of the employees themselves who are, in the last analysis, directly responsible for the effectiveness and use of any safety standards adopted. The results of studies of these groups with the co-operation of representatives of the general departments are issued as Safety Codes adopted as standard by each of the operating companies.

In view of the importance of these standards to all employees, various methods are used to insure the maximum degree of publicity. Illustrated articles are published in the company magazines. Posters showing safe methods of performing work or hazardous practices to be avoided are displayed each month by the operating companies.

First aid activities have been standardized with respect to the subject matter to be taught, the methods of teaching, and the first aid equipment provided. All companies use a textbook prepared by the American Telephone and Telegraph Company in co-operation with the American Red Cross. For the use of new employees who have not yet received formal instruction in First Aid practices, a small handbook is available containing terse directions for the treatment of the more common injuries. Through further collaboration with the Red Cross all instructors are thoroughly trained in standard first aid practices. Two first aid kits have been standardized, the larger for group use and the smaller for individual use.

Standard provisions are followed throughout the System with regard to the physical environment under which the telephone operating forces perform their duties with a view to providing the most healthful con-

ditions. These standards relate to light, heat, ventilation, rest rooms, lunch rooms, etc.

#### CO-OPERATION WITH OUTSIDE STANDARDIZING BODIES

Reference has been made from time to time in the above discussion to co-operation with outside standardizing bodies. While a very large part of the standardizing work of the Bell System is of interest in connection with its own activities alone, some of this work is of general interest and the System is co-operating in these cases with the other organizations interested for the purpose of developing standards of more general application.

The extent of this co-operative work with other organizations is illustrated by the following items:

##### *American Standards Association*

The Bell System co-operates with the United States Independent Telephone Association in the formation of the telephone group which has three representatives on the American Standards Association. The telephone group is co-operating in twelve standardizing projects under the auspices of this committee.

##### *American Institute of Electrical Engineers*

Two of the members of the Standards Committee of the A. I. E. E. are from the Bell System which is also co-operating in the work of three working committees.

##### *American Railway Association*

Representatives of the Bell System are co-operating in eleven committees engaged in standardization work relating to communication and allied problems.

##### *Institute of Radio Engineers*

Three Bell System men are members of the Standards Committee of this organization.



## *Standardization in the Bell System*

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### *American Society for Testing Material's*

The Bell System has representatives on many of their technical committees working on standard methods of tests and specifications, including those for non-ferrous metals, insulating materials, magnetic materials, protective coatings, etc.

### *National Electric Light Association*

The Bell System has formed with the N. E. L. A. a joint general committee for the purpose of developing mutually acceptable standards for the physical relations between lines of power companies and telephone companies when they are in proximity to each other, with particular reference to safety, joint use of poles and inductive co-ordination.

### *International Electrotechnical Commission*

The Bell System has three representatives on the United States National Committee of this Commission.

The above reference to some of the principal standardizing projects in which the Bell System is co-operating with other bodies is not at all inclusive but indicates in a general way the scope of this work.

## CONCLUSION

The above general outline of standardizing activities in the Bell System is sufficient to indicate the outstanding part which standardization has played in the building up of the Bell System. For many years, standardization based upon not only the present needs of the telephone system but also the best picture obtainable of future trends, has been an integral part of the program of development of telephone service. One type of standardization increases both the possibility and the advantages of another type so that in such an organiza-

tion, standardization activities ramify through the entire structure and touch every part of the work.

The total economies resulting from standardization, of course, it would be impossible to closely estimate. Standardization as indicated above, has been productive of many advantages in addition to economy. The advantages from standardization may be summarized as follows:

1. Standardization makes the best available for all.
2. Standardization reduces the cost because, when all companies use the same things, they can be manufactured in the largest quantities and uniformity in output contributes to economies in production.
3. Standardization reduces the cost of carrying stocks of materials and the cost of maintenance and repairs, because fewer parts have to be carried and maintained.
4. Standardization reduces the cost of instruction of new employees because there are fewer things with which to get acquainted.
5. Standardization reduces accounting costs because there are fewer types and sizes of materials to keep track of.
6. Standardization minimizes complicated engineering and operating problems that might result from intercommunication between widely divergent systems and apparatus.
7. Standardization renders available large supplies of materials and labor in emergencies.
8. Standardization greatly facilitates development work, since improvement in, or development of, a new article involves a co-ordination with a smaller number of associated parts.

H. S. OSBORNE.

## Abstracts of Technical Papers from Bell System Sources

*The Receiving System for Long-wave Transatlantic Radio Telephony*,<sup>1</sup> by Austin Bailey, S. W. Dean, and W. T. Wintringham. Transmission considerations and practical limitations indicate that in the lower frequency range, frequencies near 60 kc are best suited for transatlantic radio-telephone transmission. A radio receiving location in Maine gives a signal-to-noise ratio improvement over a New York location equivalent to increasing the power of the British transmitter about 50 times.

Various types of receiving antennas are briefly discussed. The wave antenna is selected as being most suitable for long-wave radio telephony. The various factors affecting wave antenna performance and methods for measuring the physical constants of wave antennas are discussed in detail. High-frequency ground conductivities determined from wave antenna measurements are given. Combination of several antennas to form arrays is found to be a desirable means of decreasing interference. The use of a wave antenna array in Maine decreases the received noise power by an additional 400 times. If the receiving were to be accomplished near New York using a loop antenna, we would have to increase the power of the British transmitting station 20,000 times to obtain the same signal-to-noise ratio. Comparisons of calculated and observed directional diagrams of wave antennas and wave antenna arrays are presented and discussed.

The transmission considerations governing the design of a radio receiver for commercial telephone reception are outlined.

<sup>1</sup> Proc. of I. R. E., December, 1928, pp. 1645-1705; Bell System Technical Journal, April, 1929.

Mathematical discussions of the wave antenna, antenna arrays, quasitilt angle, and probability of simultaneous occurrence of telegraph interference are given in the appendices.

*Electrons and Quanta*,<sup>2</sup> by C. J. Davisson. The experiments by the author and L. H. Germer, by G. P. Thomson and by others from which the wave properties of electrons are adduced are briefly described. The agreement between the results of these experiments and the prediction of L. de Broglie is pointed out. The wave and corpuscular properties of electrons are compared with the similar properties of light quanta.

*Contemporary Advances in Physics, XVIII. The Diffraction of Waves by Crystals*,<sup>3</sup> by Karl K. Darrow. This is an elementary introduction to the phenomena of diffraction of waves by crystals, one of the most striking and important discoveries of the last twenty years of physics. These phenomena have proved that X-rays and electrons are partly of the nature of waves, and have supplied the best available methods of measuring their wave-lengths; while on the other hand, the study of the diffraction-pattern of a crystalline substance makes it possible to determine the arrangement and the interrelations of the atoms with a precision and fullness heretofore unimagined, which promises and has already yielded knowledge of the greatest value in all the fields of science.

*Purified Textile Insulation for Telephone Central Office Wiring*,<sup>4</sup> by H. H. Glenn and E. B. Wood. This paper outlines methods by which silk and cotton insulation can be purified and improved. It gives the results

<sup>2</sup> Bell System Technical Journal, April, 1929. Presented at the Michelson Meeting of the Optical Society, Washington, D. C., November 1-3, 1928.

<sup>3</sup> Bell System Technical Journal, April, 1929.

<sup>4</sup> Bell System Technical Journal, April, 1929. Presented at the Winter Convention of the A. I. E. E., New York, N. Y., Jan. 28-Feb. 1, 1919; Abridgment published in A. I. E. E. Journal, February, 1929, p. 146.



of tests on the insulation properties of these materials before and after purification and explains the testing procedures. One of the findings is that the purified cotton may be substituted for ordinary commercial silk.

*Effect of Signal Distortion on Morse Telegraph Transmission Quality,*<sup>5</sup> by J. Herman. In applying telegraph transmission measuring apparatus to the development and maintenance of telegraph circuits, it is desirable to correlate quantitative measurements of telegraph signal distortion with quality of telegraph transmission. Accordingly, a series of tests has been carried out in order to determine this relationship for the case of manual operation using the American Morse Code. These tests are described and the results, together with the conclusions reached, are given in summarized form.

*A Braun Tube Hysteresigraph,*<sup>6</sup> by J. B. Johnson. In this paper apparatus for observing hysteresis loops of magnetic materials is described. It combines a cathode ray oscillograph with a vacuum tube amplifier and an electrical integrating circuit consisting of condenser and resistance. The device describes the B-H curve for alternating magnetization in the frequency range of five to perhaps several thousand periods per second. The specimens may be either long strips or closed rings. Alternating flux as low as one maxwell may be readily observed.

The operation of the apparatus is analyzed so as to account for the effects of finite time constants of the amplifier and integrator, of conductance in the condensers, of demagnetization by current in the search coil and by the stray fields of coils and specimen, and of eddy currents in the specimen.

<sup>5</sup> Bell System Technical Journal, April, 1929.

<sup>6</sup> Bell System Technical Journal, April, 1929.

*Oscillographs for Recording Transient Phenomena.*<sup>7</sup> by W. A. Marrison. In this paper oscillographs developed for recording transient phenomena are described which obtain automatically records of amplitude, wave form, frequency, duration, and time of any electrical disturbance for which they are adapted. Two instruments are described for recording very short or very long transients; these may be used in combination. At power frequencies satisfactory records may be made on film or sensitized paper with a two-watt lamp. The instruments and their performance are illustrated by photographs and oscillograms.

*Telephone Apparatus Springs.*<sup>8</sup> *A Review of the Principal Types and the Properties Desired of These Springs*, by J. R. Townsend. This article describes the types of springs employed in telephone apparatus and enumerates the engineering requirements both from the standpoint of mechanics and the quality of materials desired. The chemical and physical requirements of the spring materials are given. The importance of fatigue is emphasized and the endurance limit is given for spring brass, nickel silver and phosphor bronze.

*The Predominating Influence of Moisture and Electrolytic Material Upon Textiles as Insulators,*<sup>9</sup> by R. R. Williams and E. J. Murphy. The insulating qualities of textiles vary with the amount of moisture present in them from hour to hour and are also strongly influenced by the amount of electrolytic material (salts, etc.) which the textiles contain. Electrolytic material may be washed out producing a commercially realizable in-

<sup>7</sup> Bell System Technical Journal, April, 1929. Presented at the Regional Meeting of the Middle Eastern District of the A. I. E. E., Cincinnati, Ohio, March 20-22, 1929.

<sup>8</sup> Bell System Technical Journal, April, 1929. Presented at the Annual Meeting, New York, N. Y., Dec. 3 to 7, 1928, of The American Society of Mechanical Engineers, 29 W. 39th Street, New York, N. Y.

<sup>9</sup> Bell System Technical Journal, April, 1929. Presented at the Winter Convention of the A. I. E. E., Jan. 28-Feb. 1, 1929.

crease in insulation resistance of the order of 50 times the original value.

The resistance of the animal fibers, silk and wool, is far greater for a given moisture content than that of cotton or of cellulose acetate, a derivative of cotton. It appears probable that the distribution of water as well as the quantity is important and that the two classes of fibers are characterized by different space patterns according to which the water is distributed. It is suggested that the space distribution patterns are associated with the colloidal structures of the materials and in turn with their chemical classification as proteins and celluloses respectively. Cellulose acetate absorbs little water as compared with cotton and is correspondingly superior electrically. However its resistance varies with moisture content in the same way as that of cotton.

*Scattering of Quanta with Diminution of Frequency*,<sup>10</sup> by Karl K. Darrow. In this article the author points out that certain phenomena of X-rays recently reported were illustrations of the general process of scattering of light with change in frequency, which had just begun to attract attention owing to important observations made by Raman and others with visible and ultra-violet light. The content was amplified and restated in Dr. Darrow's article entitled "Contemporary Advances in Physics, XVII—The Scattering of Light with Change of Frequency," which appeared in the January, 1929, issue of the *Bell System Technical Journal*.

*Dissociation of Molecules as Disclosed by Band-Spectra*,<sup>11</sup> by Karl K. Darrow. This lecture was a contribution to a Symposium on Atomic Structure of the American Chemical Society. It is an elementary account of the way in which the band-spectra of molecular gases are interpreted so as to disclose the laws and de-

<sup>10</sup> Science, Vol. 68, November 16, 1928, pp. 488-490.

<sup>11</sup> Chemical Reviews, Vol. V, December, 1928, pp. 451-466.

tails of the dissociation of their molecules into atoms, a process of great scientific and some practical importance.

*Using Inspection Data to Control Quality*,<sup>12</sup> by H. F. Dodge. This paper outlines a method of using inspection data to improve the technique of controlling at economic levels the quality of product in the various stages of manufacture. Essentially, the method rests on the application of statistical methods of analysis, employing the viewpoint that every batch of manufactured product constitutes a sample from a much larger universe and as such is subject to random of chance variations in quality. The variations in quality as observed in inspection data may thus be the result of either chance causes or of fundamental production causes whose presence is undesirable.

*Speech and Hearing*,<sup>13</sup> by Harvey Fletcher. This book is concerned mainly with the results of Bell System research work on speech and hearing. These results, however, can be understood and appreciated better when their relationship to similar work is shown. Consequently, copious references to the experimental results of other workers have been included. The material is grouped under four headings: (1) Speech, (2) Music and Noise, (3) Hearing, and (4) Perception of Speech and Hearing.

The first part is concerned with the mechanism of speaking, the classification of the fundamental English speech sounds, and with the wave forms of such sounds. It includes a description of various types of apparatus which can be used for making permanent records of speech waves and gives a large number of accurate wave pictures of the speech sounds together with the power contained in such waves.

<sup>12</sup> *Manufacturing Industries*, Vol. XVI, November, 1928, pp. 517-519, and December, 1928, pp. 613-615.

<sup>13</sup> D. Van Nostrand Co., Inc., New York, 1929.



In the second part similar data are given for musical sounds and noise.

The third part begins with a discussion of a theory of hearing which is proposed to explain the experimental facts of audition. This is followed by a discussion of the known facts of audition such as the limits of audition, the minimum perceptible differences in sound, masking effects, binaural effects, methods of testing the acuity of hearing, etc. Along with this discussion is given a description of the apparatus and experimental methods used for determining these facts.

The fourth part is concerned with those phases of the subject that involve personal judgment, that is, the psychological element. A scale for measuring the loudness and the pitch of complex sounds is defined. Experimental data are given which show how these two subjective quantities depend upon external physical quantities. Methods of measuring the recognition of speech sounds are described and experimental results using such methods are given to show the effect of various types of distortion upon the ability of persons to recognize such distorted sounds.

*Elementary Differential Equations*,<sup>14</sup> by Thornton C. Fry. In this book Dr. Fry has covered the field of differential equations as usually offered in elementary courses in universities and technical schools. The mathematical ideas are first presented as mathematical entities in themselves and not as the symbolic formulation of physical concepts. With this accomplished, these ideas are broadened and illustrated by live scientific examples and problems, which are drawn from a wide variety of fields. The inclusion of such technical material does not presuppose a wider knowledge of technical subjects than the reader can reasonably be expected to possess, nor does it interfere with the clarity of the mathematical presentation.

<sup>14</sup> D. Van Nostrand Company, Inc., New York, 1929.

*Optical Conditions for Direct Scanning in Television*,<sup>15</sup> by Frank Gray and Herbert E. Ives. This paper discusses the conditions for securing the maximum amount of light in a photoelectric cell placed behind a television scanning disc when an image is formed on the disc by a lens. Results obtained with a large scanning disc and a lens forming images of sunlit objects are described.

*A Camera for Making Parallax Panoramagrams*,<sup>16</sup> by Herbert E. Ives. This paper describes a camera for making transparencies which when viewed through an opaque line grating show stereoscopic relief through a wide range of distances and angles. The essential feature of the camera is a mechanical coupling by means of which the camera lens, the sensitive plate and grating, and the object photographed, are kept in line as the camera moves from one side to the other of the normal from the camera track to the object.

*European Factory Methods and Equipment in the Manufacture of Metals*,<sup>17</sup> by David Levinger. In this paper the author outlines his observations of the metal-working industries of Europe, based on a three months' tour of eight countries during the summer of 1927, in which seventy-five industrial establishments were visited in England, France, Germany, Belgium, Holland, Italy, Austria and Switzerland.

*Electrical Conduction in Textiles. Part I—The Dependence of the Resistivity of Cotton, Silk and Wool on Relative Humidity and Moisture Content*,<sup>18</sup> by E. J. Murphy and A. C. Walker. The data reported show that the resistivity of cotton is about  $10^{12}$  times greater

<sup>15</sup> Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 17, December, 1928, pp. 428-434.

<sup>16</sup> Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 17, December, 1928, pp. 435-439.

<sup>17</sup> Mining and Metallurgy, Vol. 9, November, 1928, pp. 483-486.

<sup>18</sup> Journal of Physical Chemistry, Vol. 32, December, 1928, pp. 1761-1786.

at 1 percent humidity than at 99 percent, that is an exponential function of relative humidity in the range 20–80 percent and a power function of moisture content over the whole range investigated. By means of the equations expressing these relationships the resistance of a cotton sample can be calculated for any moisture content (or the relative humidities corresponding to it) provided a measurement has been made at a single moisture content. The curves for the logarithm of resistance vs. relative humidity (or moisture content) for samples of cotton containing different amounts of electrolytic material are parallel, low electrolyte content corresponding to high resistance. Similar but less extensive measurements were made on silk and wool. The results indicate that the conductivity of a textile is practically completely determined by three factors, the amount of absorbed water, its specific conductance (as determined by the amount of electrolytic material present in the textile) and its distribution.

*The Effect of Gases on the Resistance of Granular Carbon Contacts*,<sup>19</sup> by P. S. Olmstead. This paper describes a method whereby reproducible measurements of the resistance of granular carbon contacts can be made. The experimental arrangements were such that the resistance could be measured as a function of gas pressure, applied voltage, or time.

*Note on the Determination of the Ionization in the Upper Atmosphere*,<sup>20</sup> by J. C. Schelleng. This paper describes a method of estimating the distribution of ionization in the upper atmosphere, based upon measurements of the effective height determined by interference or echo experiments. These two types of experiment are shown to give identical results.

<sup>19</sup> Journal of Physical Chemistry, Vol. 33, January, 1929, pp. 69–80.

<sup>20</sup> Proceedings of the I. R. E., Vol. 16, November, 1928, pp. 1471–1476.

*Lead-Tin-Cadmium as a Substitute for Lead-Tin Wiping Solder*,<sup>21</sup> by Earle E. Schumacher and Edward J. Basch. In this paper data are presented which show the certain lead-tin-cadmium alloys may be advantageously substituted as solders for lead-tin alloys. Data are given showing the physical and chemical properties of these alloys.

*New Specifications for Raw Materials*,<sup>22</sup> by J. R. Townsend. In this article the author points out that the annual demand for new telephone apparatus by the Bell System requires a steady flow of materials of the proper quality and uniformity into its manufacturing plants. To meet this demand, a new set of engineering specifications has been inaugurated to control these raw materials. A notable example of this specification work is the preparation of Rockwell hardness and tensile strength requirements for sheet brass, nickel silver and phosphor bronze. The Western Electric Company, the Northern Electric Company and one of the suppliers, the American Brass Company, co-operated in this work. Rolling series were prepared covering all grades, thicknesses and tempers. The requirements were based on the data furnished by producer and consumer, and on experience over a long period with commercial material.

<sup>21</sup> *Industrial and Engineering Chemistry*, Vol. 21, January, 1929, pp. 16-19.

<sup>22</sup> *Instruments*, Vol. 1, December, 1928, pp. 519-521.



## Notes on Recent Occurrences

### NEW TOLL AND LONG DISTANCE RATES EFFECTIVE FEBRUARY 1 REPRESENT THIRD REDUCTION IN 28 MONTHS

A REDUCTION in day rates for toll and long distance telephone calls was made effective February 1 which will represent a saving to the customers annually of more than \$5,000,000. This reduction, the third in a little more than two years, cuts from \$.05 to \$.25 from charges for station-to-station calls between points from 130 to approximately 1,500 miles apart. Middle distance rates received reductions as high as 13 per cent. An equivalent rate reduction was made for person-to-person service. Evening and night rates remain at their former level. For a call from New York to Chicago the basic station-to-station day rate was reduced from \$3.25 to \$3.00. A New York-Palm Beach call or one between Denver and San Francisco now costs \$3.75 instead of \$4. Separate rates for appointment and messenger service under the new schedule are eliminated, these services being offered at regular person-to-person rates. The extra charges above person-to-person rates previously made for appointment and messenger calls are eliminated for all long distance calls so that these calls are now charged at person-to-person rates.

A little more than a year ago, President Walter S. Gifford addressed the National Association of Railroad and Utilities Commissioners, at which time he defined the fundamental policy of the Bell System as that of furnishing the best possible service at the lowest cost consistent with financial safety. This is the second substantial saving to be offered its customers by the Bell System since that address, and is further concrete

evidence of the way in which the policy operates. The previous rate reduction, effective December 1, 1927, which immediately followed this definition of policy and saved the telephone users \$1,500,000 in 1928 alone, largely concerned calls to more distant points. Another such rate reduction, representing an estimated saving to the telephone users of \$3,000,000, went into effect on October 1, 1926.

The increasing reliance of the American public upon telephone circuits between far-flung points as a business and social necessity has combined with further improved devices and methods developed by the Bell System, to effect the economies that make possible this latest lowering of rates.

### GENERAL SALES CONFERENCE

THE General Sales Supervisors of the Bell System met in New York City for the first System Sales Conference January 28 to February 2, inclusive. The Conference was attended by 48 representatives from the Associated Companies, the Long Lines Department of the American Company and the Bell Telephone Company of Canada and also by various officials and members of the Headquarters Staff in New York. H. C. Lauderback, Sales and Development Engineer of the A. T. and T. Co., presided throughout the Conference.

The work of the Conference was divided into five general groups:

1. Exchange Sales.
2. Toll Sales.
3. Organization and Personnel Problems.
4. Sales Information and Advertising.
5. Customer Relations.

The various subjects were presented in papers prepared by both Associated Company and A. T. and T. Company representatives, with the Associated Com-

pany representatives presenting the greater number of subjects.

Particular stress was laid upon the importance of maintaining sales work in its proper relationship to overall telephone operations. Our motive should be not to sell all of the service that can be sold—but to sell only the service which, in the judgment of the management, it is good business to sell at the time, considering all of the circumstances.

It was developed that the formulation of sales plans having definitely in mind the particular phases of operation which each type of sales activity was intended to improve, should be helpful in securing the best possible direction of sales effort. Accordingly the discussion of Exchange Sales Planning was directed and results information presented under the following headings: Planning to Improve Subscriber Service, Planning to Utilize Idle or Spare Plant, Planning to Utilize Rate Schedules most Effectively, Planning to Promote a Greater Use of the Service. Discussion of Exchange Sales Activities was divided into such subjects as Participation of all Departments in Sales Work, Stimulated Sales in the Business Office, Obtaining New Subscribers, Regrading Activities, Sale of Auxiliary Services and By-Product Service, Sale of Public and Semi-Public Services, Sales to Promote Convenient Telephone Service in Homes and Commercial Service Activities. The presentation of the general subject of Toll Sales Planning was followed by discussions of Toll Sales Activities including Sales to Promote a Greater Use of Toll Service among Business Subscribers, Sales to Promote a Greater Use among Residence Subscribers and the Key Town Plan of Selling by Telephone.

President J. S. McCulloh of the New York Telephone Company welcomed the conference to the Headquarters' Building of the New York Company at 140 West Street, where the conference was held.

Vice President A. W. Page addressed the conferees on the close relationship existing between sales activities and the work of the Information Departments. R. H. Burcher discussed phases of plant operation affecting sales activities. H. H. Carter, General Commercial Manager, Long Lines Department, outlined the sales plans and activities of that Department. Improvements in traffic operation and their effect on exchange and toll development as indicated in past performance were discussed by A. J. Allen. Equipment problems, including the provision of new instrumentalities, were presented by W. H. Harrison.

L. B. Wilson was present at all sessions of the Conference, and addressed the Conference on various phases of commercial operation. C. Wallace, H. H. Shearer, and Z. Z. Hugus presented the rate, directory, and employee training aspects of sales activities. Visitors to the conference included W. J. O'Connor, T. T. Cook, H. E. Darling of the New England Company, Southern Area, M. B. Downing, A. D. Welch, W. A. Kietzman, and K. S. McHugh of the New York Telephone Company, F. M. McEniry, Wisconsin Telephone Company, and F. M. Hoag of the Southwestern Bell Telephone Company.

Emphasis was given throughout the Conference to the Customer Relations Aspects of Sales Activities and the general conception of Sales Activities as a means of rounding out and perfecting the communication facilities of customers.

## CONFERENCE OF BELL SYSTEM EDITORS

A CONFERENCE of editors of the employee magazines published by Bell System operating companies, the Western Electric Company and the Bell Telephone Laboratories was held at 195 Broadway, February 25th to 28th, inclusive. It was the first separate conference of the editors as a group, their pre-



vious meetings having been as members of general publicity conferences. The general theme of the discussion was the function of the System magazines in stimulating and maintaining the *esprit de corps* of telephone men and women. Addresses were made during the conference by President W. S. Gifford, and Vice Presidents A. W. Page, E. K. Hall and B. Gherardi.

#### TRANSATLANTIC SERVICE TO LUXEMBURG

AMERICAN telephone users were enabled to reach directly one of the smallest independent European states on and after March 1, when transatlantic telephone service was extended to include the City of Luxemburg, capital of the Grand Duchy of Luxemburg. The rate for a telephone conversation from New York is \$48.00 for the first three minutes and \$16.00 for each additional minute.

The Duchy is smaller than Rhode Island. It has a population of 270,000, served by 9,000 telephones. The City of Luxemburg numbers 50,000 inhabitants.

#### BELL LINES USED FOR INAUGURATION BROADCASTING AND TELEPHOTOGRAPHS

THE Bell System had an important part to play on March 4 during the inauguration of President Hoover and Vice-President Curtis. More than 30,000 miles of telephone program circuit carried the inaugural ceremonies to 118 radio stations in all parts of the country, making the occasion the largest chain broadcast which has ever occurred. By means of a number of pick-up circuits furnished by local loops from the various points where events connected with the inauguration took place, complete descriptions of all the occurrences of the day were supplied to the listening public. During the lunch hour in Washington, President Hoover listened to a program of celebration from his home town, Palo Alto, California, brought east over

one of the transcontinental circuits. Pictures of the inauguration were sent to newspapers throughout the country through a special telephotograph station established temporarily at Washington.

#### RADIO BROADCASTING NETWORKS

Microphones were located at the White House, the Senate Chamber, the east steps of the Capitol, the Peace Monument, on Pennsylvania Avenue near the Capitol, the Treasury Building, and at other points. The broadcasting companies also had facilities in aircraft above the route of the inaugural parade and sent out the reports of observers overhead. The broadcast of the vice-presidential ceremonies in the Senate Chamber was of special interest since this was the first time this has taken place, a regulation previously preventing the placing of wires in the Senate Chamber. Local public address systems were in operation at the east steps of the Capitol and also at the reviewing stand at the White House, and enabled great audiences to hear the proceedings.

All of the radio stations regularly on broadcasting networks were furnished service on this occasion along with a number of special additions. The larger broadcasting companies had coast-to-coast circuits, and their programs were available to practically every radio listener in the country. The exercises were also heard by many listeners in distant countries through high frequency short-wave transmission from various stations. It was reported that one of these transmissions was successfully received in the Hawaiian Islands and re-transmitted over the ordinary broadcasting facilities.

#### TELEPHOTOGRAPH FACILITIES

A telephotograph station was temporarily installed in Washington to handle pictures of the inauguration. Beginning the evening before the ceremony, this office,

located in the quarters of the Chesapeake and Potomac Telephone Company, transmitted thirty-two photographs, of which about half were sent to all eight stations on the telephotograph circuit, namely: New York, Boston, Cleveland, Chicago, St. Louis, Los Angeles, San Francisco and Atlanta. The views were then sent out by messenger, airplane, etc., so that news agencies and newspapers all over the United States were able to utilize these first pictures of the change of administrations. A force of men from the Long Lines telephotograph, commercial and plant departments took charge of the installation.

Commenting on the telephotograph service in connection with the inauguration, the *New York Evening Post* said editorially:

"It was an interesting fact that the telephotographs served to the *Post* by Pacific and Atlantic Photos, Inc., came to this office with the speed and precision of the news of the day. They were in this office almost as quickly as the written words sent over the telegraph wires."

#### SURPASSES PREVIOUS INAUGURATIONS

The completeness of the radio description, the many millions of listeners who heard the ceremonies, and the transmission of pictures by wire to distant cities, make a vivid contrast with 1917 when the late President Wilson was inaugurated the second time. On this occasion there was neither a public address system nor radio broadcasting. The inauguration of President Harding in 1921 was the first at which the audience had the benefit of a public address system. In 1925 twenty radio stations transmitted the inaugural ceremonies and 20,000,000 persons, it is estimated, heard Calvin Coolidge take the oath at the beginning of his four-year term. Estimates of the number of listeners to the Hoover inauguration run far higher.

## ANNUAL MEETING OF STOCKHOLDERS

At the annual election of directors by the stockholders of the American Telephone and Telegraph Company on March 26, Charles Francis Adams, now Secretary of the Navy, and Edwin Farnham Greene retired from the Board. To fill these vacancies, and the vacancy caused by the death of John I. Waterbury, the stockholders added to the Board Thomas Nelson Perkins of Boston, Owen J. Roberts of Philadelphia, and Myron C. Taylor of New York. The remaining sixteen directors were reelected.

The stockholders voted in favor of an increase in the authorized capital stock from \$1,500,000,000 to \$2,000,000,000. There were 8,616,201 shares voted in favor and 8 shares voted against.

## NEW DIRECTORS OF THE A. T & T. CO.

**A**T its meeting on February 20th, the board of directors of the American Telephone and Telegraph Company elected John W. Davis a director to fill the vacancy caused by the death of Charles E. Hubbard. Mr. Davis, who was Democratic nominee for President in 1924, is a member of the law firm of Davis, Polk, Wardwell, Gardiner & Reed, of New York City. He is also a director of the National Bank of Commerce and a trustee of the Mutual Life Insurance Company.

Thomas Nelson Perkins, who was elected a director on March 26, is a member of the Boston law firm of Ropes, Gray, Boyden and Perkins. He is vice president of the Railway and Light Securities Company, a director of the Merrimac Chemical Company, director and chairman of the Executive Committee of the Puget Sound Power and Light Company and a director and member of the Executive Committee of the Boston and Maine Railroad. During the World War he was a member of the Priorities Committee, chief counsel for the War Industries Board, member of the American



Commission to the Inter-Allied War Conference at Paris, assistant to Secretary of War and assistant director of munitions. He is a fellow of Harvard College.

Owen J. Roberts, who was also elected a director on March 26, is engaged in the practice of law at Philadelphia, as a member of the firm of Roberts and Montgomery. He is a director of the Bell Telephone Company of Pennsylvania, the Real Estate Title Insurance and Trust Company, the Franklin Fire Insurance Company and the Equitable Life Assurance Society of the United States. During the war Mr. Roberts was appointed special deputy attorney-general to represent the United States Government in the prosecution of certain cases and he also represented the United States Housing Corporation in Philadelphia.

The third new director elected on March 26 is Myron C. Taylor, who is chairman of the Finance Committee of the United States Steel Corporation, president and director of Myron Taylor and Company, Inc., and director of the First National Bank of New York, the New York Central Railroad Company, and the Lehigh and Wilkes-Barre Corporation. He is a director and member of the Finance Committee of the Atchison, Topeka and Santa Fe Railway Company and a trustee and member of the Finance Committee of the Mutual Life Insurance Company of New York.

## Organization Changes

### CHESAPEAKE AND POTOMAC TELEPHONE COMPANY

*M. D. Sedam elected Vice-President.*

Entered employ of the Bell System as Directory Clerk, Central Union Telephone Company, Indianapolis, 1903; Service Inspector, February, 1904; Chief Clerk and Service Manager, May, 1904; Chief Clerk and Manager, December, 1904; Toll Chief Operator, 1904; District Chief Operator, 1905; Special Agent, Pacific Telephone and Telegraph Company, San Francisco, 1907; City Chief Operator, 1907; Division Superintendent of Traffic, Los Angeles, August, 1908; Traffic Superintendent, Southern California Telephone Company, May, 1917; Division Superintendent of Traffic, Pacific Telephone and Telegraph Company, San Francisco, October, 1919; General Superintendent of Traffic, Chesapeake and Potomac Telephone Company, Washington, D. C., February, 1922; General Traffic Manager, June, 1924; General Manager, May, 1927; Vice-President, February, 1929.

### PACIFIC TELEPHONE AND TELEGRAPH COMPANY

*R. H. Marwick appointed General Plant Manager, Southern California Area.*

Entered employ of the Bell System as Assistant Engineer, New York Telephone Company, Brooklyn, N. Y., April 8, 1911; Engineer, June, 1912; Supervising Foreman, May, 1915; Engineer, June, 1915; District Plant Engineer, August, 1916; Engineer, American Telephone and Telegraph Company, New York City, September, 1920; District Plant Engineer, New York Telephone Company, Brooklyn, December, 1922; Outside Plant Engineer, Southern California Telephone Company, Los Angeles, August, 1924; Division Plant

## *Organization Changes*

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Manager, February, 1928; General Plant Manager, Pacific Telephone and Telegraph Company, Southern California Area, January, 1929.

*I. F. Dix appointed Assistant to General Manager, Oregon-Washington-Idaho Area.*

Entered employ of the Bell System as Engineer, New York T. & T. Co., Newark, N. J., 1904; District Engineer, 1907; Division Plant Chief, Pacific Telephone and Telegraph Company, Los Angeles, 1909; Division Plant Engineer, 1911; Plant Engineer, Southern California Telephone Company, May, 1917; Plant Superintendent, January, 1919; General Plant Manager, January, 1926; Assistant to General Manager, Pacific Telephone and Telegraph Company, Oregon-Washington-Idaho Area, January, 1929.

### BELL TELEPHONE LABORATORIES, INC.

*H. P. Charlesworth elected Vice-President.*

Entered employ of the Bell System engaging in circuit development engineering, American Telephone and Telegraph Company, Boston, 1905; Toll Traffic Engineering, New York City, 1907; Engineer, 1909; Plant Engineer, April, 1920; Vice-President, Bell Telephone Laboratories, Inc., December 24, 1928.

### BELL TELEPHONE SECURITIES COMPANY

*Clinton S. Van Cise elected Vice-President.*

Entered employ of the Bell System as Bookkeeper, New York Telephone Company, New York City, July, 1914; Clerk, April, 1916; Accountant, March, 1919; Supervising Accountant, April, 1919; Clerk, American Telephone and Telegraph Company, January, 1921; Methods, Financial Department, May, 1921; Assistant to Treasurer, January, 1923; Assistant Treasurer, March, 1923; Vice-President, Bell Telephone Securities Company, December, 1928.





# BELL TELEPHONE QUARTERLY

A MEDIUM OF SUGGESTION  
AND A RECORD OF PROGRESS

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## Extension of Telephone Service to Ships at Sea

THE project of extending telephone service to ships at sea, upon which experiments were conducted some years ago, is being actively taken up anew. Arrangements are being made to construct shore receiving and transmitting stations somewhere in New Jersey, suitable for handling a general service along the Atlantic steamship lanes, and for the installation of a model transmitter and receiver aboard the S. S. "Leviathan." Pending the completion of the commercial shore transmitting station, the initial engineering tests will be carried out from the Deal Beach experimental station.

What is believed to have been the first instance of two-way radiotelephony, through the telephone wire network to a vessel at sea, took place as far back as 1916. On that occasion the Secretary of the Navy in Washington and the captain of the U. S. S. "New Hampshire" carried on a two-way conversation over land lines and radio connections. This trial was conducted by engineers of the Bell System in cooperation with the Navy Department as a part of the communica-

[ 175 ]

tions preparedness work which the System carried on at that time with the Government.

The experience thus gained was applied when the United States entered the World War to the development of telephone sets for intercommunication between ships. Sets of this type were manufactured by the Western Electric Company. A considerable number of installations were made on submarine chasers and other installations were made on ships of various types.

An extensive experimental investigation underlying the development of ship-to-shore telephony for general public service was undertaken during the years 1919 to 1922. At that time there was built the station at Deal Beach, N. J., which has since been used for experimental work and for transatlantic short-wave telephony. Connections were made with several coastal and transatlantic ships. In addition to extensive engineering measurements and tests, numerous calls were made between these ships and various points in the land line system. A number of demonstrations were made both to telephone officials and to others of the physical feasibility of connecting ships at sea into the telephone network and thereby permitting telephone communication between a person on shipboard and practically any telephone subscriber on land.

Although these telephone trials were successful from the technical standpoint, the development was not carried to the point of the establishment of service to the public because commercial conditions, including the adverse economic conditions which prevailed in the shipping world, did not appear to justify at that time the establishment of a new service of this kind.

Since that time, however, a great increase has occurred in steamship travel and in the use by the public of long-distance telephone facilities. The possibilities of using short waves for long-distance communication have been demonstrated and transatlantic short-wave circuits established. The time therefore, now appears

to be opportune for undertaking anew the project of ship-to-shore telephone service.

Since the time of the earlier experiments, the technical picture has changed materially. The frequencies of about 1000 kilocycles, which were used in these earlier trials, were soon thereafter devoted to broadcasting services. Lower frequencies than these are occupied quite completely by telegraph services of various kinds and do not afford the necessary opportunity for ship-to-shore telephone development. It is, therefore, to the high-frequency (short-wave) end of the radio spectrum that we must now look for the development of this new service. The frequencies involved are those higher than 3000 kilocycles, corresponding to wave lengths of less than 100 meters. These frequencies are quite different in their transmission characteristics from those employed in the earlier work, and require a different technique. They present disadvantages due to fading, but they do have certain advantages in reaching ships at great distances.

One of the important factors in ship-to-shore communication is that of obtaining assignments to the necessary frequencies. In our present undertaking, for example, an assignment of three sets of frequencies will be required at the outset for the frequency used will depend upon the distance of the vessel and the time of day. Only a few years ago no use was being made of these higher frequencies, but important results obtained with them during the last few years have led to a large demand for the assignment of channels in this region of the spectrum.

In view of the fact that radio telegraph service has for so long been given to ships at sea as to be now rather commonplace, the question of why there should be problems in radio telephony may well be raised. The answer is, as all telephone people will realize, that telephony is inherently a more difficult problem technically, and requires the meeting of higher standards of trans-

mission than ordinary hand telegraphy. The difference between the two is especially pronounced in the case of service to ships where it may not always be possible to render the same quality of service as in overland wire service. Furthermore, the telegraph transmission can be degraded much further without serious sacrifice in its usefulness. Also, the telephone user cannot be expected to tolerate the same amount of interference and general variability of reception and delay as will skilled telegraph operators.

Because of this greater ease with which telegraphy can utilize the radio medium, it seems apparent that it will always have a place in the field of marine communication. Telephony, however, should contribute greatly toward overcoming the isolation of ocean travel by adding the entirely new factor of a continued personal contact with shore.

A-ship-to-shore telephone service presents also a number of problems which are not present in point-to-point radiotelephony. These problems are mostly bound up with the fact that on shipboard the radio transmitting equipment and the receiving apparatus must be located in close proximity to each other, while on land they may be separated as illustrated by the transatlantic stations. Interference with reception on the part of the radiotelephone transmitter will be obviated in the proposed trial installation by means of voice-operated relays which will actuate the transmitter only at such times as the subscriber on shipboard is actually speaking.

Furthermore, on board vessels such as the "Leviathan," the telegraph traffic is practically continuous and avoidance of radio interference between the two services is probably the most difficult problem which will come up for solution. On large vessels the telephone and telegraph services must obviously be carried out simultaneously. This will entail the development of highly selective apparatus, not only for the telephone



equipment, but also for the radiotelegraph equipment associated with it, and will require cooperation with the agency operating the telegraph equipment. On the first few vessels to be equipped with radiotelephony, this interference problem will be met by specific engineering for the vessel involved, but the whole matter of the relationship between the telephone and the telegraph services will need to be worked out more completely as telephone service comes into more general use.

Another shipboard problem is that of interference with the radiotelephone reception from disturbances arising in the electrical equipment of the ship. It is, in general, impossible to avoid all troubles of this kind and special shielding, both of the receiving apparatus and some of the machinery, will need to be resorted to in order to keep this trouble down to a minimum. An investigation of this problem was made on a number of vessels during 1925-27, in which the general receiving conditions at short wave lengths were studied. Quantitative measurements were also made of short-wave transmission from the Deal Beach station during the course of the vessels to and from New York.

The shipboard receiving conditions make desirable the transmission from the shore of about as much power as is used in the short-wave transatlantic system. It is, therefore, planned to install in the shore station the same equipment as is used at the Lawrenceville transatlantic station. In the case of transatlantic vessels the course is along fairly well defined routes, which will make possible the use of directive antennas for transmitting to them. Antennas of this type are of very great value, since they concentrate the energy of the radio waves in the direction required and, hence, serve the twofold purpose of producing a greater signal at the receiving station and of reducing interference in unwanted directions. On account of the width of the transatlantic lane, however, the concentration of the

transmitted energy by this means cannot be carried out to the same degree as in the transatlantic service, where a definite point is aimed at, but, nevertheless, substantial increase in the signal strength can be expected. At the shore receiving station directive antennas will also be used and equipment similar to that used in the Netcong transatlantic station will be employed. Supplementary antenna arrangements may be necessary for the handling of the coastwise service.

The apparatus on board the "Leviathan," while experimental in character, will, nevertheless, embody all the features necessary for commercial operation and it is anticipated that at the end of the experimental period it will be suitable for extended commercial use. The transmitter used on the ship, however, does not need to be as powerful as that of the connecting land stations, since receiving conditions on land are more favorable than on shipboard.

The actual carrying out of the ship program will involve the following steps: The determination of the actual receiving conditions on the "Leviathan"; the installation and adjustment of the equipment to those local conditions; the making of engineering tests on the overall system; and the extension of these tests to a commercial trial of service from telephone subscribers to ships at sea.

LLOYD ESPENSCHIED,  
WILLIAM WILSON.

## Telephone Typewriters and Auxiliary Arrangements

PRINTING over telegraph circuits is an old art, inventors having devised such arrangements previous to the invention of the telephone. Over 50 years ago the manufacturing organization, which grew into the Western Electric Company, constructed and sold printing telegraph machines under the patents of Elisha Gray. It was not until about 1909, however, that systematic printing telegraph development work was started by Bell System engineers, primarily to meet the requirements of telegraph message service as they were understood at that time. This work led to a multiplex system of four channels working in each direction at 52 words per minute per channel over a single wire, a system which included a mechanism for printing a single copy on a roll of paper of standard page width. A printer operating directly from a keyboard for working over short circuits was also developed.

Further consideration of the requirements of telegraph service and especially those of the American Telephone and Telegraph Company, led to the development of an intercommunicating system capable of operating over composited telephone circuits and having sending keyboards resembling typewriter keyboards, and to the development of new types of receiving machines, one designed for printing on a page and capable of making as many copies as can be made on a typewriter, and the other a machine for printing on a narrow strip of paper or tape. The intercommunicating system was so arranged that any sending station in a network could obtain control of the circuit at will. In other words, a "conversational" path between printing telegraph instruments was provided which was analogous to that provided by telephony and printer operators could carry on "conversations" between

stations connected to the same network with facility. The name "telephone typewriter" service, therefore, seemed very appropriate.

Of the present machines available for Bell System telephone typewriter service, three may be mentioned in particular. These instruments illustrated in Figs. 1, 2 and 3 are as follows:

1. A tape telephone typewriter which prints on a narrow strip of paper or tape.
2. A page telephone typewriter which prints on a wide sheet of paper (usually 8½ in. wide).
3. An automatic sending machine which provides for sending from a perforated strip which acts as a storage medium for the message.

The machines illustrated by Figs. 1 and 2 can be arranged for receiving only by omitting the sending keyboards.

The tape machine is very popular for a communication service in which the individual communications are short, do not require more than one copy and need not be kept on file for any great length of time. However, if so desired, the tape can be pasted on a blank to give the appearance of a page message. The page machine is found to be very satisfactory for longer communications which are kept for future reference, for making multiple copies, and in some cases for handling special forms. From the point of view of handling telegraph traffic the page system is not quite so efficient, because the signals controlling the operations of feeding the paper and of returning the carriage to the beginning of each line have to be transmitted over the circuit by the sending operator. These operations are not required with the tape printer.

Machines for sending from a perforated strip find their use where a large volume of traffic is to be handled as in press offices. The message in the perforated strip form will pass through the sending mechanism or transmitter at a regular rate, say 360 characters per minute





FIG. 1. Tape Telephone Typewriter



FIG. 2. Page Telephone Typewriter



FIG. 3. Automatic Sending Machine





but the operator in preparing the message in this form for transmittal can exceed this speed and, therefore, have a freedom of working which is found to be quite desirable. This uniform speed of transmitting over the circuit corresponds with the fastest working of most operators who are employed to prepare the perforated strip.

Fig. 4 illustrates the arrangement of our present standard keyboard, together with a representation of the code combinations for each character as they appear in the perforated strip used with automatic send-

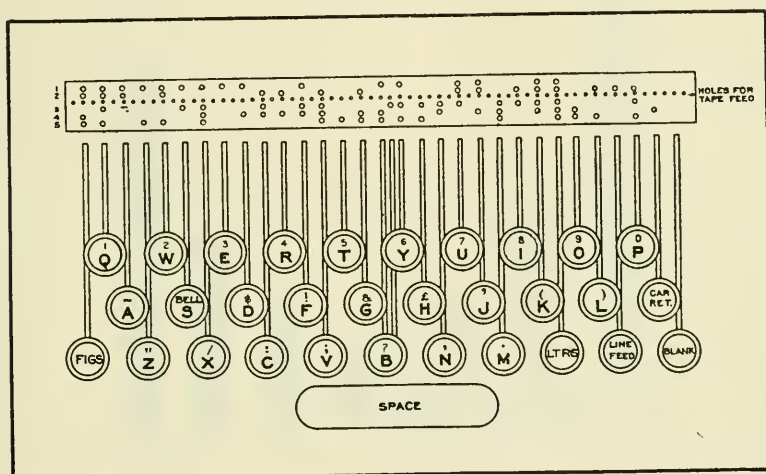


FIG. 4. Telephone Typewriter Keyboard and Corresponding Code Combinations

ing machines. The code always contains five elements per character equal with respect to time and represented in the electrical circuit by signaling impulses transmitted successively by a distributor. Differentiation between characters is obtained by giving each of these impulses either one or the other of two characteristics, and thus we have two to the fifth power or 32 possible code combinations, enabling the 26 letters of the alphabet to be selected and necessary machine functions to be controlled such as the shift operation for printing upper case characters, carriage return, etc.

A very desirable feature of this code is the fact that the same number of equal impulses is employed in selecting each character. This simplifies selecting mechanisms and makes telegraph repeating arrangements practicable for regenerating the telegraph im-

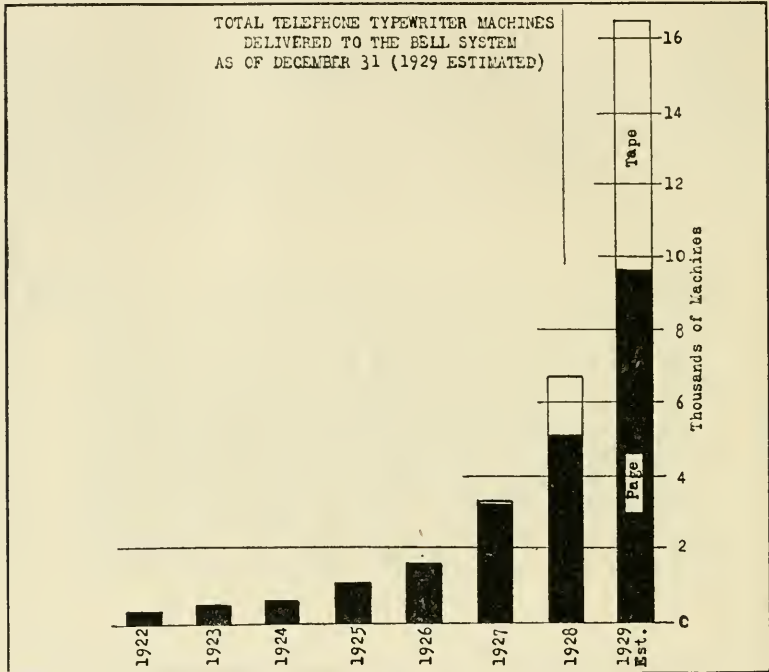


FIG. 5

pulses. Thus, with a long circuit or a complicated network having many sending and receiving points we are able to give a satisfactory service since we can insert one of these regenerative repeaters at some strategic point and bring the telegraphic impulses, which may become distorted due to line conditions, back to the original form which they had at the sending station.

Though the code illustrated above has five equal successive pulses per character and enables any one of 32 different conditions to be selected, it is necessary to add two more pulses to this code if to and fro or intercom-

municating service between stations on a network is to be given. One impulse added at the beginning of the selecting group and known as the "start" impulse initiates a timed movement at each receiving station; another impulse of opposite polarity is then necessary at the end of the selecting group to terminate this move-

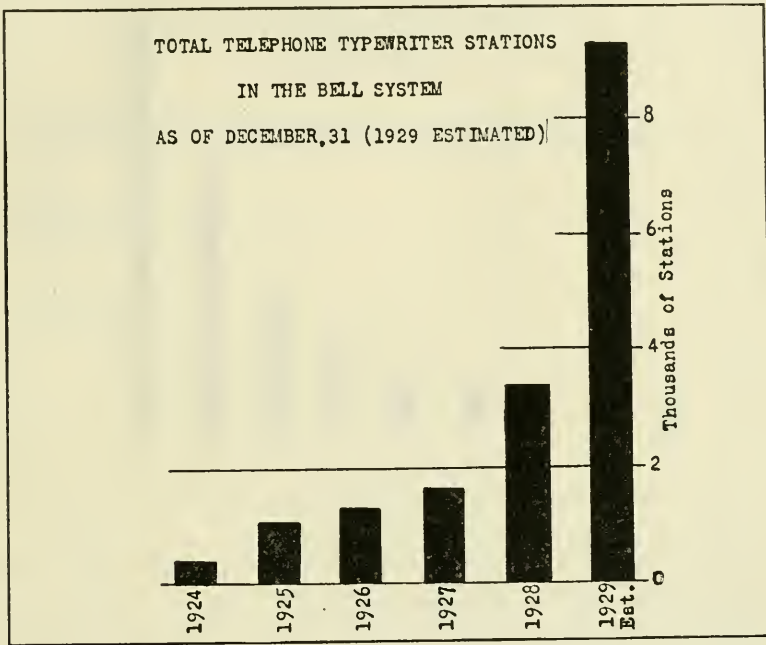


FIG. 6

ment. This last impulse is known as the "stop" impulse and together they have caused the system to be universally known as the "start-stop" system.

The circuits used in networks required for telephone typewriter service may be obtained by the various arrangements which have been devised for securing telegraph channels from telephone circuits, such as simplexing, compositing and carrier arrangements.

The demand for telephone typewriter service on the part of press associations, business houses and others during the past few years has exceeded our earlier estimates. This rapid expansion is illustrated by Fig.

5 which shows the number of machines delivered to the Bell System during the past few years together with an estimate for this year. It is to be noted that in 1929, the estimate shows purchases of considerably more than twice the number of machines purchased in 1928. Fig.

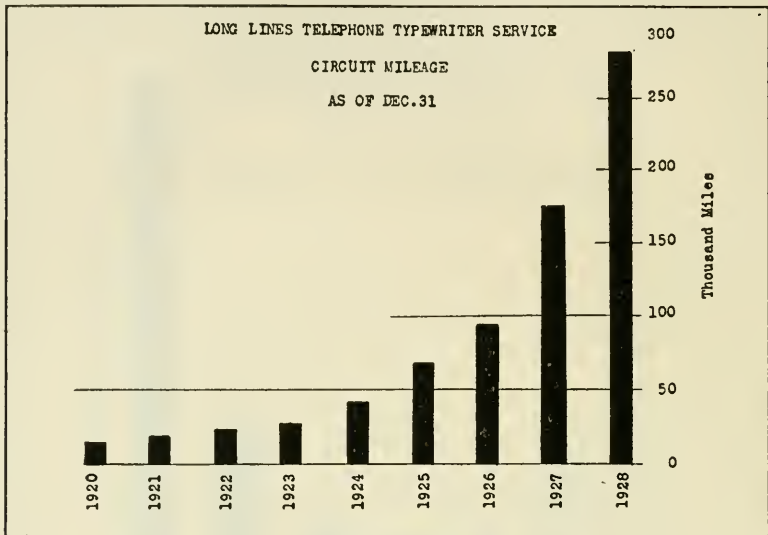


Fig. 7

6 illustrates the expansion in the number of stations in the system over a similar period of time but since two machines are generally installed at stations on important long-line circuits in order to insure uninterrupted service, the number of stations is considerably less than the total number of machines added.

The telephone typewriter method of obtaining interoffice communication with its speed, flexibility, and accuracy has found extensive application in newspaper offices, banks, brokerage offices, factories and businesses of many kinds throughout the country as well as in our own official business. On May 31, 1929, approximately 396,000 circuit miles of telephone typewriter service were handled under contracts held by the Long Lines Department alone and in addition over 30,000 miles was in use by the American Telephone and Telegraph Com-



pany for its own business. The growth of the contract mileage is indicated in Fig. 7, and Fig. 8 illustrates a division of the Long Lines' telephone typewriter service as of March 31, 1929, into the three classes: press, broker and general commercial applications.

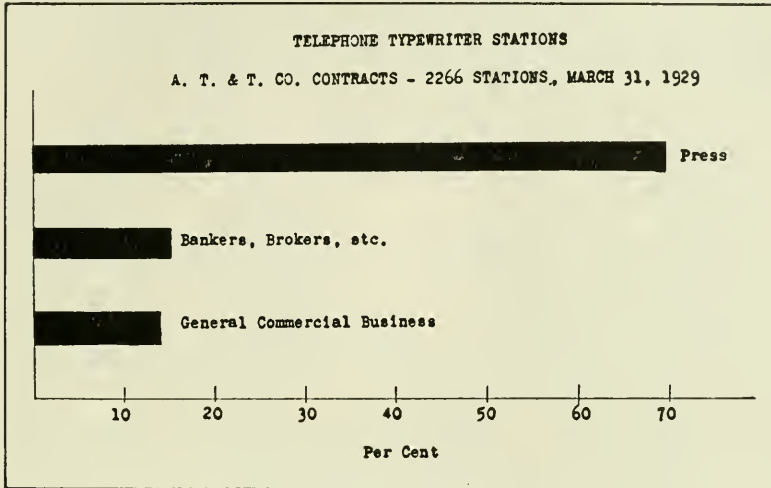


FIG. 8

Some of the applications of this service will now be described.

#### PRESS SERVICE

Thus far the most extensive use of telephone typewriter service has been for the press. Practically all of the large press associations handle a large part of their telegraphic traffic by this service over Bell System circuits. The mileage of circuit used for the press at this time is about 250,000. Approximately 3500 machines are used.

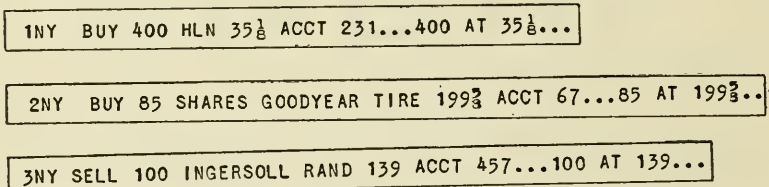
An interesting recent development in connection with the introduction of this service has been the use of tape machines to handle stock exchange reports given out by press associations. It was formerly thought that this traffic would always have to be handled by telegraph operators who, using abbreviations, would send out the information so that the receiving operators

could manually insert price figures in the proper places on forms. It is now found that the tape telephone typewriter instrument is fast, accurate and quite satisfactory, since the short pieces of tape on which prices are printed by the receiving machines can be pasted on the market forms ready for the linotype operators.

Fig. 9 is a view of a typical press association telegraph office.

#### BROKER SERVICE

It is only recently that conditions were such that a satisfactory telephone typewriter service could be given to brokers, but the response has been such that it is expected that a substantial part of the circuit mileage required for this class of our customers will be handled by telephone typewriter instruments in a comparatively short time. Since the traffic consists largely of short



1NY BUY 400 HLN 35 $\frac{1}{8}$  ACCT 231...400 AT 35 $\frac{1}{8}$ ...

2NY BUY 85 SHARES GOODYEAR TIRE 199 $\frac{3}{8}$  ACCT 67...85 AT 199 $\frac{3}{8}$ ...

3NY SELL 100 INGERSOLL RAND 139 ACCT 457...100 AT 139...

Fig. 10. Typical Broker's Orders.

statements, requests for prices, and other market information, the tape printer has been found to be very satisfactory. Special equipment has been provided in some cases so that very little time is lost between the printing of a character and the pasting of it on a blank for use in the office. Fig. 10 is a reproduction of typical orders printed on the tape and Fig. 11 an interior view of a large brokerage office in New York, showing the telephone typewriter machines.

#### POLICE DEPARTMENT SERVICE

Telephone typewriters have been found particularly serviceable in handling police items and alarms, espe-



FIG. 9. Typical Press Association Telegraph Office







Fig. 11. Tape Telephone Typewriters in a Broker's Office

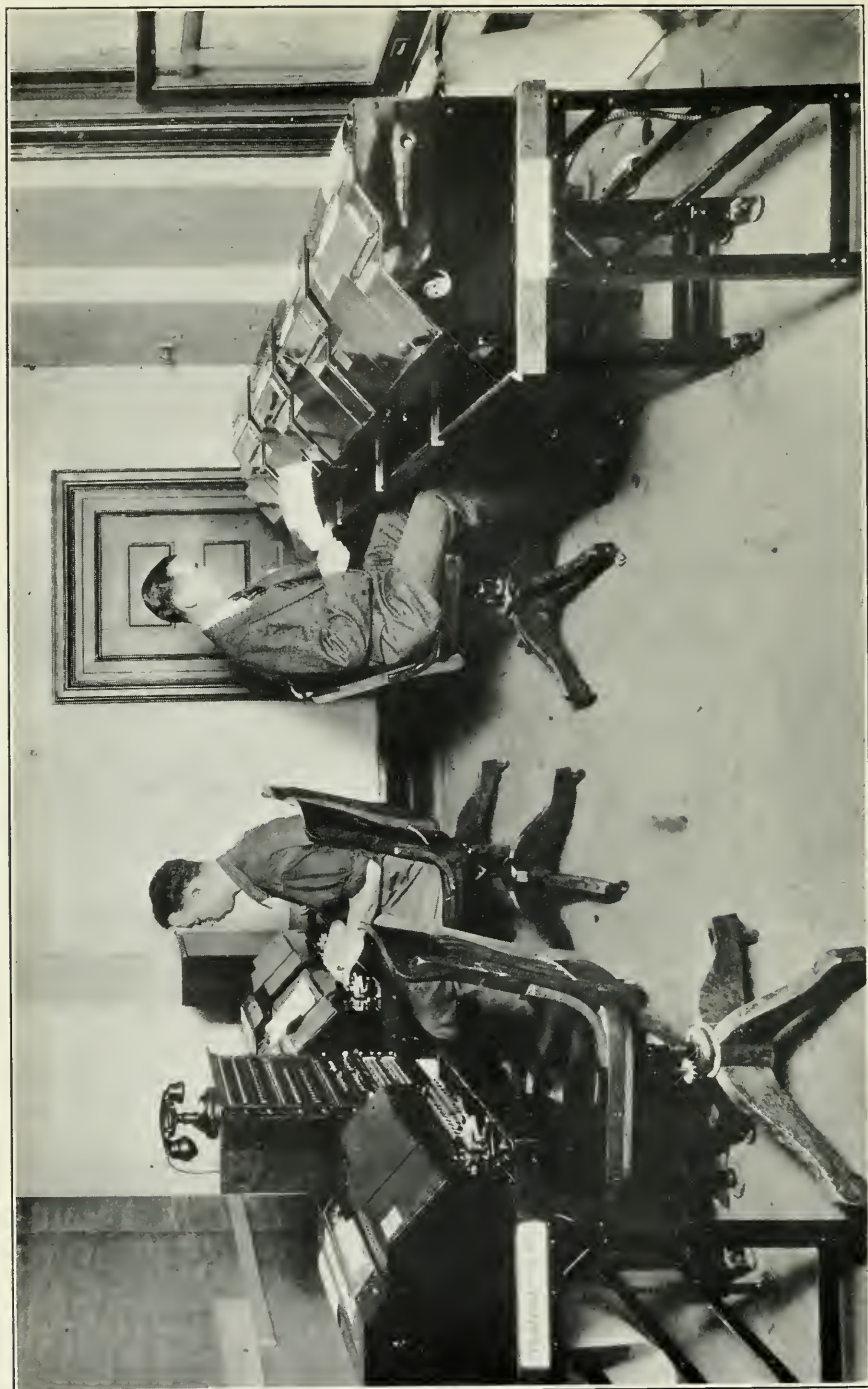


FIG. 12. Page Telephone Typewriters and Switchboard in Police Headquarters, New York City

cially in those cases where an alarm is to be broadcast over a network to a large number of receiving points where records are kept for future reference. For this purpose comparatively simple switching systems have been devised so that any one or any group of a number

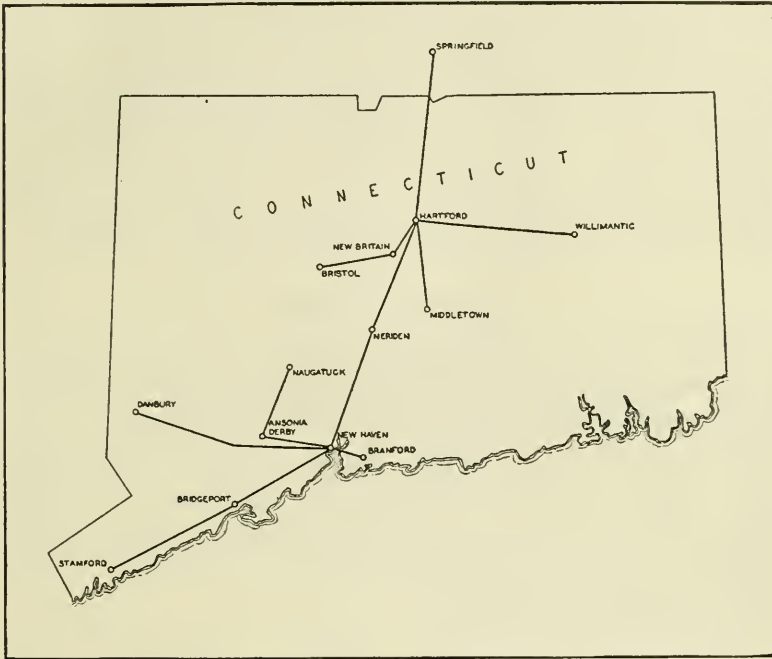


FIG. 13. Telephone Typewriter Network for Connecticut Police

of stations can be quickly connected to a single sending instrument at Headquarters and acknowledgment given to Headquarters of the receipt of the message at each receiving station. The fact that the instrument at the receiving point does not require an attendant at the time the message, which may be in multiple copy form, is coming in is also quite a valuable feature.

One very important police department installation was made in New York about a year ago. In this installation each borough headquarters is provided with sending equipment and switching arrangements for enabling police items to be sent to one or any group of



the borough precinct police stations. In addition, tie lines are provided from Manhattan Headquarters to each of the other borough headquarters so that general police alarms can be flashed without delay to all precincts in the greater city. A view of the installation at Police Headquarters, Borough of Manhattan, is shown by Fig. 12.

The telephone typewriter has also been found valuable for state-wide use by police organizations and Fig. 13 illustrates such a police network now operating in Connecticut. There are 14 cities and towns connected in this network which is so arranged that any station can receive from and send to all the other stations.

#### AIRWAY SERVICE

The need for quickly reporting weather conditions at airway stations has been satisfied for a number of the larger flying fields by providing telephone typewriter service over trunk lines between these fields. At regular intervals the weather reports, particularly those affecting flying, are passed between the stations together with other information concerning the arrival and departure of planes.

#### GENERAL COMMERCIAL APPLICATIONS

Commercial concerns in general are finding telephone typewriter service particularly useful. Thus, a business man may dictate the terms of a price change, or an important announcement in connection with his business, and a typist transmits this information in a few seconds to all of the stations of a network which this concern may use to cover the country. Again a central business office may wish to transmit orders for coal or other supplies to outlying supply depots and the telephone typewriter with a switching system is found to be the most convenient and satisfactory method.



An office in a large city is connected by telephone typewriter with a factory in a suburban town. Orders received in the office are transmitted to the factory and

FIG. 14. Order for Merchandise Handled by Page Telephone Typewriter.

printed on a special form. Copies of these forms are also made at the sending station, one of which may be kept for record purposes, another sent to the salesman, and still another copy to the concern that has

placed the order. Many hours may be saved by these methods. A reproduction of a typical order placed on a form by a telephone typewriter instrument is shown in Fig. 14.

It is a comparatively simple matter to provide switching arrangements so that a central sending station of a network can be connected to any one, any group or all of the other stations for sending and receiving messages. Furthermore, any station can be connected by the central operators to any other station. Fig. 15 shows a typical small switching cabinet of this type which may be placed alongside of the telephone typewriter machine so that the operator can send and receive messages and make switching connections as may be desired.

#### TELEPHONE TYPEWRITER EXCHANGE SERVICE

The Bell System provides equipment and circuits and gives a service which permits subscribers to handle their own messages, telephone or telegraph, in their own way. Telephone typewriter instruments have to a large degree the flexibility of telephone instruments and can be interconnected through suitable switchboards in the same manner. It is, therefore, quite feasible to provide a large number of subscribers in their business offices with these instruments and to furnish wire interconnections between these subscribers as they may indicate their desires. The service need not be confined to a single city but any subscriber in New York may be connected to any subscriber similarly equipped in some other city, the time required to complete this connection being of the same order as that required to complete a telephone connection between the same two points. A service of this character is analogous to present telephone service in that the subscriber would, in general, provide his own telephone typewriter operator and on the completion of the de-

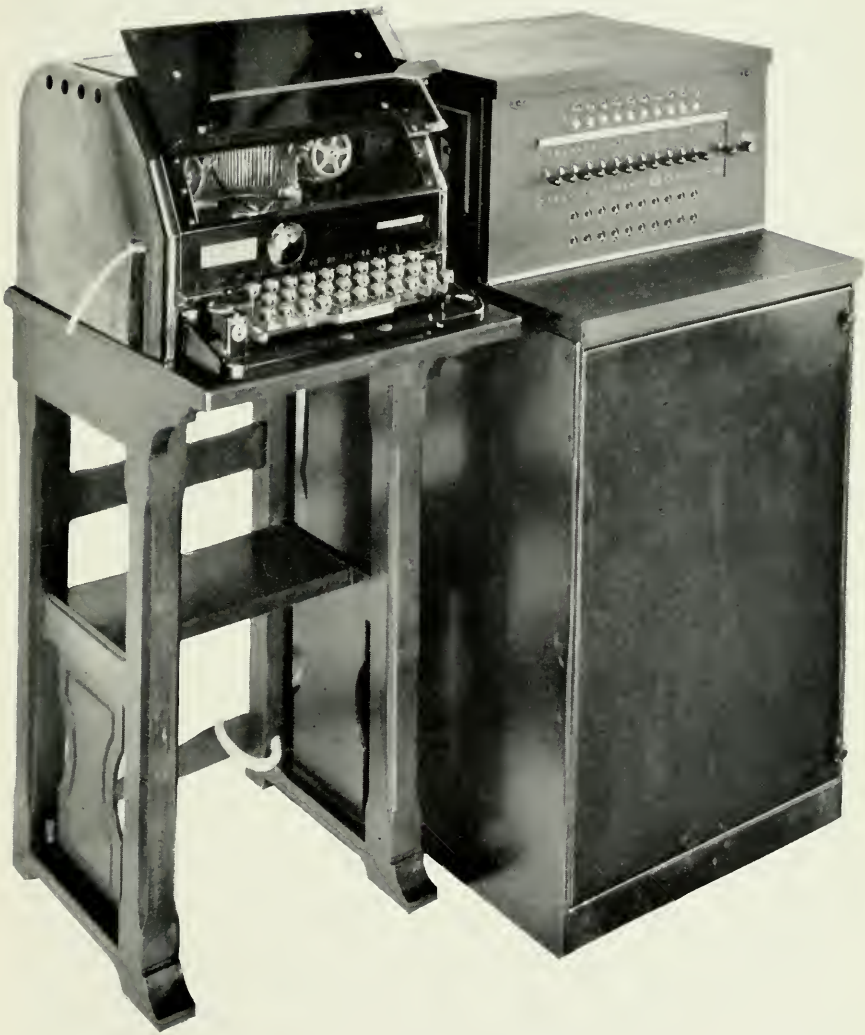


FIG. 15. Tape Telephone Typewriter with 10-Line Switching Cabinet

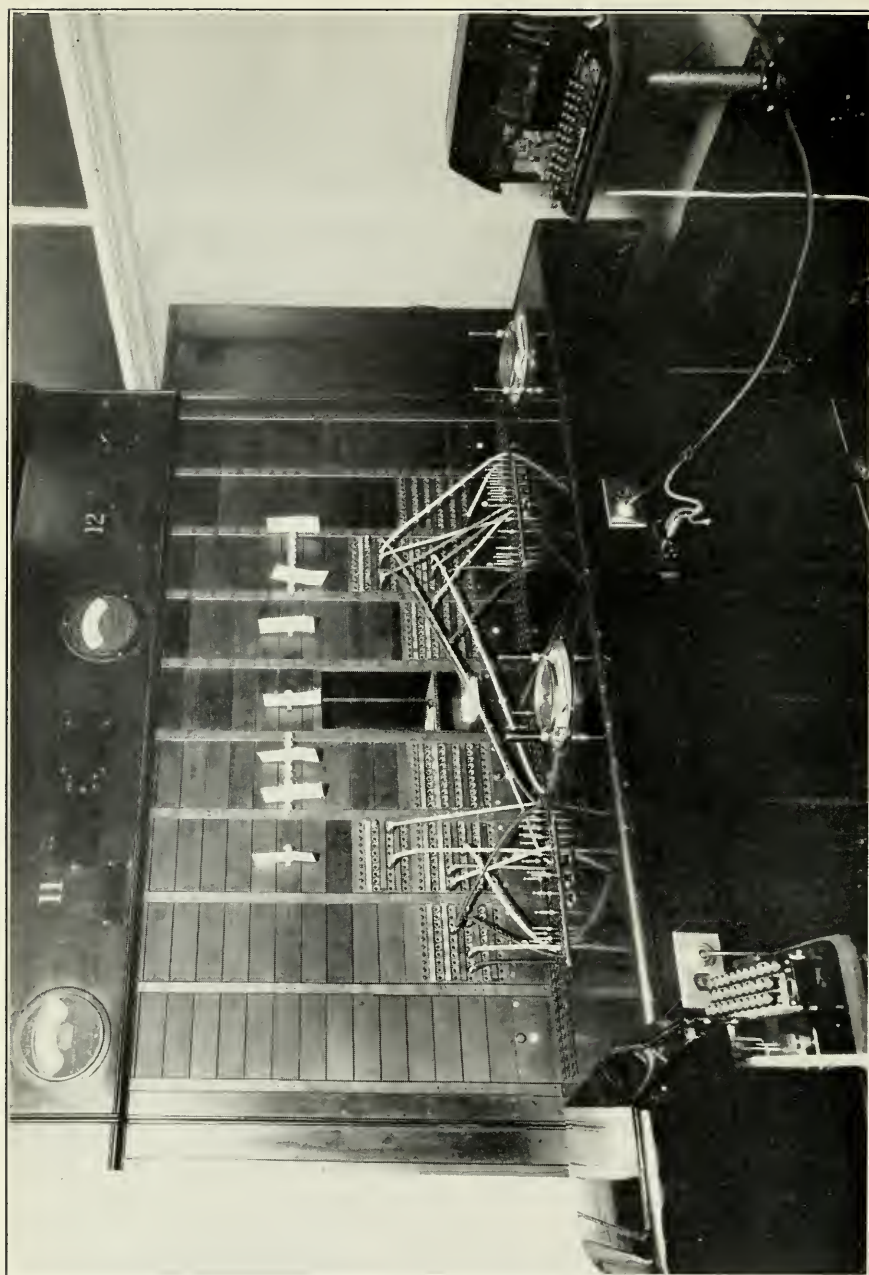


FIG. 17. Switchboard for Telephone Typewriter Exchange Service



sired connection to the called subscriber would handle his messages in any way that he saw fit.

An experimental service of this character has been established between switchboards and stations installed in telephone company offices in New York, Boston and Chicago and some adjacent cities. The circuit layout for this installation is shown in diagrammatic form in Fig. 16 and Fig. 17 shows the switchboard installed in New York. All information concerning calls is

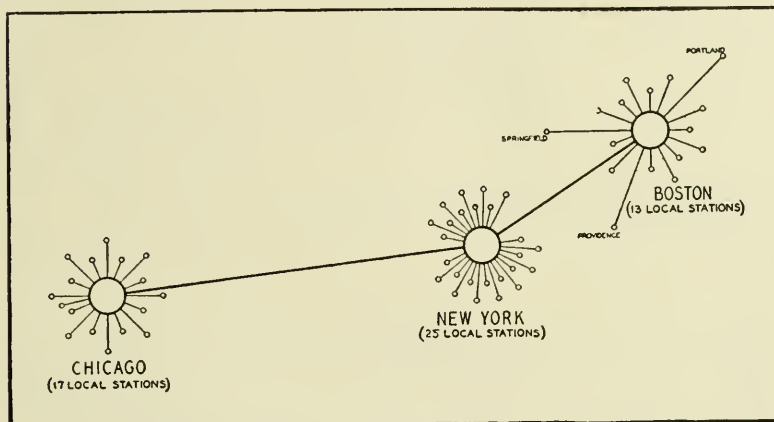


FIG. 16. Circuit Layout for Telephone Typewriter Exchange Service

handled by telephone typewriter instruments and it has been found that a direct connection between a station in New York and a station in Chicago can be made in a very short time, while connections between Boston and Chicago or the reverse requiring one switch at New York also adds but little to the time required.

When placing a call, the subscriber merely switches on the power at his station which is analogous to lifting the receiver from the hook. This operation lights a line lamp at the telephone typewriter switchboard and the operator responds by connecting his telephone typewriter instrument to the calling subscriber's line and writing the letters, for example, "NY OPR." The calling subscriber types the station connection desired and awaits response from the called subscriber

or from the operator if the connection cannot be completed. A typical message of this character showing, in addition, a record of the information passed between the subscribers and the operators is shown in Fig. 18.

|                                                                                                                                                                                                                                                                              |                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| NY OPR                                                                                                                                                                                                                                                                       | ←New York Operator's Response |
| CGO 89 FOR NY 1                                                                                                                                                                                                                                                              | ←New York Patron's Call       |
| OK                                                                                                                                                                                                                                                                           | ←New York Operator            |
| CGO OPR                                                                                                                                                                                                                                                                      | ←Chicago Operator's Response  |
| NY TO CGO 89                                                                                                                                                                                                                                                                 | ←New York Operator            |
| OK                                                                                                                                                                                                                                                                           | ←Chicago Operator             |
| THIS IS CGO 89                                                                                                                                                                                                                                                               | ←Chicago Patron's Response    |
| T55-NY 1 - APR 22, 1929 9:25 AM                                                                                                                                                                                                                                              |                               |
| MR. J. W. WOLCOTT, GENERAL SALES ENGINEER,<br>ILLINOIS BELL TELEPHONE COMPANY - STATE AREA,<br>CHICAGO, ILLINOIS.                                                                                                                                                            |                               |
| REFERENCE OUR TELEPHONE CONVERSATION THIS MORNING. HAVE CHECKED<br>WITH OUR MAILING DAPARTMENT AND FIND THAT 2000 COPIES OF FORM E-822<br>WERE SENT YOU EXPRESS ON APRIL 10. IF YOU DO NOT RECEIVE THEM<br>WITHIN A DAY OR SO PLEASE ADVISE AND I WILL SEND 2000 ADDITIONAL. |                               |
| F W GALWAY                                                                                                                                                                                                                                                                   |                               |
| FWG - MBK                                                                                                                                                                                                                                                                    |                               |
| FINIS 9:28                                                                                                                                                                                                                                                                   |                               |
| CLR                                                                                                                                                                                                                                                                          | ←New York Patron              |
| OK                                                                                                                                                                                                                                                                           | ←Chicago Patron's Response    |

FIG. 18. Typical Message Handled by Telephone Typewriter Exchange Service

Explanatory notes are added to indicate the sequence of operations and the character of the necessary information which is required to enable the call to be properly completed.

R. D. PARKER.

## An Interview with President W. S. Gifford

*Excerpts from a newspaper report in the Montreal "Gazette" of May 24, 1929, of an interview with Mr. Walter S. Gifford, President of the American Telephone and Telegraph Company.*

YESTERDAY, up in the mountain peak of the new Bell Telephone offices on Beaver Hall Hill, Mr. Gifford told The Gazette some surprising things about the telephone business, about the progress of all industry and about life and men in general, and The Gazette, by a series of questions, learned something about Mr. Gifford himself and how he directs a corporation with 400,000 people on its staff and 450,000 people owning its shares.

Mr. Gifford foresaw the day, "in due time," when a man in Montreal will be able to pick up his telephone and without hanging up speak instantly with a man in Vancouver as easily as one speaks across the city today.

He told of the new ten million dollar plan to lay a telephone cable across the Atlantic by which, within the next few years, conversation with London and Paris will be as easy and certain as it now is between Montreal and Toronto.

He pictured the common use of telephone communication between land and aeroplanes, moving trains and ships at sea or between two moving objects, and the possible application of television to practical use. And, with these as examples, he expressed his belief that we are today developing a new form of civilization with constantly increasing freedom and wealth for the individual.

"A great many people seem to be afraid," Mr. Gifford said, "that we are in a material age, and that we are becoming standardized. I believe the opposite is true. I think our present industrial system is produc-

ing a liberty of thought and action for the individual such as history has never known.

"Not long ago the only way a man obtained wealth was by taking it from other men. One individual became wealthy; a great many others became poorer. That is not the case today."

#### WEALTH FROM NATURE

"How is wealth obtained today, Mr. Gifford?" The Gazette asked.

"Today we are taking wealth from nature," Mr. Gifford said. "Science is showing how it can be done and industry is doing it. The alliance between science and industry is producing new wealth for the benefit of all. The result is a more general level of wealth, less drudgery, greater freedom for the individual. The man driving a tractor in his field is better off than the man with his hoe a few years ago. The man tending an automatic stoker is better off than the man feeding a furnace by shovel. There is more time for the individual to develop himself than ever before."

"And is he doing it?" was the query.

"Ah, that is a different matter. I do not say that the best use is being made of the new time which the individual has. I merely say that the time is there for him to use. If the best use perhaps is not being made of it I think that will work itself out. We are not altogether accustomed to this new freedom yet."

Mr. Gifford was asked about the developments in telephony which he had mentioned. "Are these things all being accomplished through science, Mr. Gifford?"

"Yes. You have probably heard of our research laboratories. We have about five thousand men there engaged in studying telephone problems and applying the results they find."

"How much do you spend a year in that work, Mr. Gifford?"

"We are spending about twelve million dollars a



year now in research alone. That is a large sum of money, but it is yielding splendid returns. It is not only producing better and better telephone service; it is also preventing increases in costs by finding more efficient methods of production."

"Are television and the trans-Atlantic telephone the results of such research?" was a further question.

"Yes," Mr. Gifford replied, "but a great deal of the most important research work is connected with matters which are less spectacular. Television and radio are wonderful achievements. They have wiped out distance in sight and sound, for by means of them we now can see and hear from one end of the earth to the other. But I would not describe such things as our chief aim in the telephone business."

#### BELL'S CHIEF AIM

"What is your chief aim?", The Gazette asked. "Our chief aim is to make everyday telephone service better and better. We are making progress. A few years ago when you put in a long distance call you were obliged to hang up your receiver and wait, perhaps a considerable time, before your call was completed. Today we have immediate communication between many cities.

"When you call Toronto from Montreal now, if you give the Toronto number you want, your call is usually completed within two minutes or so while you hold the receiver. A man in Kansas City can now get a number in New York almost immediately, a distance of about two thousand miles."

"Will the day come when we shall be able to talk with Vancouver on that basis?" The Gazette asked.

"Yes," Mr. Gifford said, "that will certainly come in due time. It is chiefly a matter now of being able to build the necessary facilities. That is the sort of service toward which we are working in the United

States and toward which I know the Bell Telephone Company is working here."

"Where does research come into that, Mr. Gifford?"

"Research produced the mechanical equipment in the first place," Mr. Gifford replied, "and it is constantly discovering new economies which make it possible to give this better communication without great increase in cost. For example, our research people may make a study of a simple thing like telephone cord. That has no direct relation to instant service between Montreal and Vancouver, but if they develop a cord which will wear better they may reduce general costs by several million dollars, and that makes possible improvement in service without corresponding increase in cost."

Mr. Gifford himself is an exponent of the greater freedom which he believes modern industry has produced for the individual. There is none of the captain of industry front about him. He has none of the tricks of the big executive in the movies. He shows no evidence of the hurry and stress which most people associate with big business. He finished Harvard when he was nineteen, and decided he had better get a job. He wrote an application which he intended to send to the General Electric Company, but by mistake he sent it to the Western Electric, which is an associated company of the American Telephone and Telegraph.

He got the job and began as a clerk. He found a way to do the work he was given so much more quickly than it had been done that he was all finished for the day by two or three o'clock in the afternoon. Instead of trying to appear busy when he was not, young Gifford thereupon started going home in the middle of the afternoon. He might have been fired, but his boss decided to have a look at a young man with as much efficiency and as much nerve as that and the rest of the

story is simple: a sure steady climb to the top of the heap by the time he was forty.

Today, at forty-four, Mr. Gifford is a pleasant unworried individual, interested in everything and disturbed by nothing. He treats life casually, does his best all the time, and doesn't take fright if things go wrong.

The Gazette asked him yesterday about his job. "Do you find that you have to work very much harder now than when you were a clerk, Mr. Gifford?"

"No. I don't think so. It's a little difficult for me to say because I like this work so much. I'm not always sure when I'm working and when I'm not."

"Do you follow regular office hours or do you travel around the country all the time?"

"Oh, I have pretty regular programme for the day. I'm usually at my office every day."

"Do you do much work at nights?"

"I never work at nights. And I never work Saturday afternoon or Sunday. I do my work in the ordinary day."

"But when do you get time for thinking and planning?"

"I doubt very much if a man ever shuts himself in a room, sits down and says to himself: 'Now, I'm going to think.' At least if he does, I doubt if he does much thinking. Most good thinking is spontaneous. It comes when you're shaving or when you are talking with people. It is sometimes almost sub-conscious."

"What is your biggest problem?"

"I suppose it is keeping up enthusiasm and keeping enthusiasm in others. Or perhaps it is finding good men. The most important thing in any business is to find the right men. And when you find them the thing is to let them do their work. An executive should never do anything which he can delegate to somebody else."

LESS BUNK IN BUSINESS

"Do you think there is less bunk about business than there used to be, Mr. Gifford?"

"Much less. The pretentious conferences, the domineering executive, the stuffed shirt, are all going or gone. We don't shout at people nowadays and hammer the desk. We really hardly give orders. We suggest certain courses of action and the man who carries them out does his work better because he contributes something to the decision."

"Do you take exercise to keep fit, Mr. Gifford?"

"No."

"Not golf?"

"No. About four times a year. Obviously, therefore, I don't play golf well enough to like it. I never think about my health and perhaps for that reason I have good health. It is often the men who worry about health and follow all sorts of rules who become ill."

"Do you diet?"

"No. I eat what I want to eat and I probably smoke too much. There are too many interesting things in the world to fill your head with rules about health and rules about success. You read of one man who achieved success by great attention to detail. You read of another success who paid no attention to detail at all. What are you to believe? The answer is that you should follow your own course. The things which suit me may suit nobody else. Certainly they are not rules for success."

"What is success, Mr. Gifford?"

"Success is reaching the limit of your capacity and ability. A man in a small job may be more successful than a man in a big one."



## Bell System Buildings—an Interpretation

FORTUNATE indeed is the traveler who catches his first glimpse of New York from the deck of an in-coming ship. As the vessel steams through the Narrows and across the Upper Bay to her North River pier, the New York skyline is unfolded in a changing panorama unique in its groupings of mass and form. The tall buildings that cluster about the lower end of Manhattan Island stand out sharply with pinnacles, pyramids and colonnaded summits outlined against the sky. Here and there a wisp of light gray smoke or steam floats lazily from the top of one of these man-made cliffs. A few low buildings accentuate the height of the skyscrapers. It is a blasé traveler who will stay below while his ship is passing the Battery.

As she slowly wends her way up the Hudson, escorted by puffing tugs, the vessel leaves behind the towering range of the down-town office-buildings. The city spreads out in a wide plateau of lesser structures over which loom here and there isolated buildings or groups of buildings of heroic proportions. One of the most impressive of these, seen from the river, is the massive pile which a French commentator has described as possessing "a certain barbaric majesty," the New York Telephone Building.

Alone, dominating the low buildings on the adjoining blocks, it rises by gargantuan steps and terraces and set-backs, drawing the eye irresistibly upward to its massive summit. Deep shadows lurk in recesses half a dozen stories in height, but the sun and the wind from the river have full play on the myriad windows that glitter in the vast buff surfaces of the structure. It is no mere brick box, like so many of the earlier skyscrapers. It expresses something. It has personality—this telephone building.

West-bound, another steamship moves slowly away from the Embarcadero and heads into San Francisco Bay en route to the Golden Gate and thence out into the Pacific Ocean. The passengers, gathered at the rail for a last look at the City, see vivid against the California sky a great white tower. Its proportions, its soaring lines give to this building an aspect almost of delicacy, despite its size. The monumental effect is heightened by the whiteness of the structure and by its aloofness.

Like that other building far away on the banks of the Hudson, this too, stands alone, a giant in comparison with those about it. High it towers above the section south of Market Street—this new Telephone Building, headquarters of the Pacific Telephone and Telegraph Company. And, gazing at it, the traveler cannot but feel that this building, too, stands for more than stone and steel and mortar,—that it represents not unworthily a certain spirit and a certain aspiration.

#### MANY EXPRESSIONS OF THE SAME POLICY

These two buildings, separated by a Continent, stand physically nearly three thousand miles apart. Yet they are two tangible expressions of a spirit and an aspiration common to the organizations which reared them and to the nation-wide organization of which each is a part. They are representative of the best in modern telephone architecture, but they are not unique. Almost midway between them—at St. Louis—there stands another great castellated pile which houses and typifies the headquarters of the Southwestern Bell Telephone Company. Denver, too, has such a building. So has Cleveland. So has Newark. So has Montreal. But these and others of like magnitude are only one form in which the building policy of the Bell System is expressed.

Had our traveler looked about him in New York, in San Francisco, or in almost any considerable town



ADMINISTRATION BUILDING OF THE NEW YORK TELEPHONE CO., NEW YORK, N. Y.





ADMINISTRATION BUILDING OF THE NEW JERSEY BELL TELEPHONE CO., NEWARK, N. J.



between, he would have found other telephone buildings, smaller, less monumental, but to the seeing eye not less expressive of the spirit that animates the telephone organization.

#### BUILDINGS APPROPRIATE TO THEIR SURROUNDINGS

Among these smaller structures are many which are frankly business buildings in business neighborhoods, conveniently located, economically constructed, designed to promote the most efficient service to the public with adequate provision for the health and comfort of the telephone workers. Some of these structures are ornaments to their localities, as for example the buildings at Syracuse, Pontiac, Oklahoma City, Dallas, and many other places. Certain of them have been designed to conform to a well-defined local architectural tradition, witness the Spanish style of the telephone buildings at Ventura, California, Phoenix, Arizona, and elsewhere, and the Colonial brick buildings in Maryland and other Eastern States. The new telephone building at Dallas, Texas, will be a notable example of the application of the Aztec architecture of the Southwest to modern American requirements. In San Francisco's Chinatown is a telephone building in Chinese style.

Still others among the smaller telephone buildings are situated in suburban or other strictly residential areas. Many of these have been designed to have all the outward appearance of private residences in keeping with the best local standards of construction. Such are, for example, the brick and limestone Warwood, West Virginia, telephone building, and the Colonial brick building with white doorway, shutters and roof rail at Silver Spring, Maryland. Despite its use as a thoroughly modern telephone office, this building would not have looked out of place to Washington's Continentals, had they passed it on one of their long marches during the Revolutionary War.

At Scituate, Massachusetts, stands a telephone exchange which looks every inch a comfortable modern New England rural home. Its picket fence and weathered shingles fit into the Massachusetts landscape as naturally as the wind-swept wild roses by the New England roadside.

At Hamilton, Ontario, a telephone building adjacent to a church has been erected in the Gothic style of architecture which harmonizes with the surroundings.

#### UNATTENDED BUILDINGS

Another interesting development of recent years in the housing of Bell System telephone plant has been the erection of small buildings to shelter unattended dial switching equipment. In these little structures the intricate apparatus alone effects connections between subscriber and subscriber, picking out with uncanny accuracy, the telephone lines whose numbers are dialed, while no eye sees, no ear hears, the moving parts in their orderly though complicated maneuvers. These unattended central offices have given rise to some pretty problems, for example, how to keep them at the best temperature for the apparatus and for the plant maintenance men who occasionally visit them to give the equipment necessary attention. But especially careful thought has been given to the exterior appearance of the little buildings to the end that they, too, may blend into their surroundings and fittingly exemplify the determination of the Bell Telephone organization to have its buildings worthily represent good taste and devotion to public service. Very different in conception, yet well suited to their respective locations, are such unattended buildings as the one known as Delmar, Albany, New York, and those at Piru and Arcadia, California.

SOME CHARACTERISTICS COMMON TO TELEPHONE BUILDINGS AS A GROUP

These diminutive structures stand at the opposite end of the scale from such monumental buildings as the headquarters of the New York Telephone Company—the largest telephone building in the world—with its three-quarters of a million square feet of floor space, housing six thousand people as well as equipment serving close to one hundred thousand telephones. Yet both exemplify the same spirit, the same aspiration, and each is planned and constructed with a view to best serving the public needs of its particular locality, as are other telephone buildings of every intermediate size.

There are roughly six thousand buildings in the Bell System, of which almost half are company-owned (This is exclusive of those occupied by the Western Electric Company, Incorporated, with its huge manufacturing plants at Hawthorne, Illinois, and Kearny, New Jersey, and storehouses elsewhere throughout the country, not to mention its other great industrial plant under construction at Point Breeze, Maryland.)

The Bell Telephone Company-owned properties represent a capital investment of approximately sixty-five million dollars in land and two hundred and ninety-five million dollars in buildings. This is probably the largest group of buildings belonging to any one organization in the United States. During 1928, one hundred and twenty-two new buildings and thirty-nine additions to buildings were erected. The program for 1929 includes two hundred new buildings and eighty major additions. It is an undertaking of some magnitude.

But mere size in and of itself is of less significance than what stands behind it. What qualities, then, do these thousands of buildings have in common? What is it that they express—more especially those of them which have been added to the group during the last few years and those now under construction or planned for the future?

## UTILITY

First of all—utility. Of course, the *raison d'être* of the whole vast fabric is to serve, to be useful, to provide adequate, efficient and economical telephone communication. Obviously the primary consideration in planning telephone buildings, as in every other form of telephone construction, is how best to meet these requirements. And in this the telephone engineers have been notably successful. To mention but one among many examples: uniform floor plans for central office equipment have been worked out, applicable to various types of equipment and to the varied conditions as to available space. Economy and efficiency in the installation, operation, maintenance, expansion and replacement of central office equipment is materially enhanced by the use of these uniform floor plans.

## BEAUTY

Another consideration which follows so closely after utility as scarcely to be subordinate to it, is beauty—beauty of line, of form, of detail, of mass, of setting, of color; beauty of exterior and of interior.

One of the most significant tendencies of our time is the emergence of an appreciation of beauty in American life—the development of a national taste too long obscured by intensive absorption in material progress. The modern cry for beauty reflects the emergence of a new spirit in American civilization, an outgrowth of the new prosperity and leisure of today. The hunger of the heart for beauty, starved for generations, is gradually being satisfied.

You see it everywhere—this modern flair for the beautiful. The new trend finds expression in countless ways and in many places. In interior decoration, in motor-cars, in fountain-pens, in telephones, utility has ceased to be all-sufficient. There must be beauty, too.

In no field of American endeavor, probably, has





ADMINISTRATION BUILDING OF THE SOUTHWESTERN BELL TELEPHONE CO., ST. LOUIS, MO.



ADMINISTRATION BUILDING OF THE PACIFIC TELEPHONE AND TELEGRAPH CO., SAN FRANCISCO, CALIF.

there been more marked progress toward the attainment of beauty in recent years than in architecture. Discriminating use of choice woods, face brick, stucco, limestone and other materials gives individuality and distinction to homes and business buildings of the better sort. Progressive architects today seek a style that will harmonize with its surroundings and be appropriate to the climate and perhaps to the historical background of the locality. Developing, modifying, adapting to new conditions the architectural styles of the Old World, our architects are gradually working toward the creation of a distinctively American school, which today finds expression particularly in what has been called the "American perpendicular" style employed in some of our modern skyscrapers.

#### A DISTINCTIVELY AMERICAN ARCHITECTURAL FORM

This architectural form may be briefly described in non-technical language as placing emphasis on perpendicular lines which lead the eye upward unchecked by horizontal interruptions, save where, at intervals, succeeding tiers of stories are set back, leaving terraces which lend to the finished structure somewhat the effect of a gigantic step-sided pyramid, surmounted perhaps by a lofty central tower. This type of construction, besides being immensely impressive, has very practical value in admitting an abundance of light and air not only to the building itself but to the street below. New York and other municipalities, anxious to avoid having additional business streets transformed into dim canyons with the perpendicular walls of closely set skyscrapers rising continuously from the building line, have adopted zoning regulations which require the upper stories of high buildings to be set back at levels varying with the width of the street on which they front. With the impetus thus given to the use of this new type of architecture, imaginative artists are already portraying the city of the future as a vast ex-



panse of pyramidal buildings rising step by step to the limits of economical construction.

Among the most notable examples of this new architectural style are the group of headquarters buildings completed during the last few years by Associated Companies of the Bell System at New York, Newark, Cleveland, Saint Louis and San Francisco. *L'Illustration*, the famous French weekly, published an article some time ago on the evolution of the skyscraper in the development of American cities. Out of five representative American skyscrapers shown in full page illustrations in this French publication, three were telephone buildings—those at St. Louis, New York and San Francisco. The other two were the Chicago Tribune Building and the Woolworth Building.

The Bell System may fairly be said to have made an outstanding contribution to the development of one of the most hopeful trends in modern American architecture—the working out of a distinctive style adapted to American conditions and expressing something of the vitality and aspiration as well as the solidity which we like to believe are representative of the best elements in our modern American business life.

#### ADAPTATION TO A DEFINITE PURPOSE

The undeniable beauty achieved by a happy application of this distinctive style is not only a beauty of line and mass and grouping. These telephone buildings have also the beauty which comes from appropriateness to their surroundings and adaptation to the purpose for which they were designed. These qualities are shared by many of the smallest and most unpretentious telephone buildings as well as by the skyscrapers. The modest and home-like central office building, indistinguishable from the comfortable residences by which it is surrounded, exemplifies the aims toward which the Bell System is striving as truly as the thirty-two story metropolitan headquarters structure. Util-



ity, beauty, appropriateness to its location, adaptation to the purpose in hand—each is characterized by these same qualities, each is a different manifestation of the same spirit.

#### MODERNITY

Modernity is another quality shared even by the telephone buildings which are outwardly faithful reproductions of Colonial homes. For what is more modern than the up-to-date telephone equipment which these buildings house?—an equipment that makes possible word-of-mouth communication across the Continent or across the Atlantic, and puts within reach of any Bell System customer 28,200,000 telephones in North America and Europe, or 85% of all the telephones in the world.

In such matters as fire protection, ventilation, sanitation, and intelligent provision for the comfort and convenience of customers and workers, also, the telephone buildings are thoroughly modern. The inviting cafeterias and rest-rooms for employees off duty, auditoriums for conferences and employee training-courses, and the completely equipped medical departments in the larger buildings are additional evidence of the up-to-date standards that have been adopted.

In the decorative arts, what is modern shades by degrees into what is modernistic. In the interiors of its newer buildings the Bell System has made use of decorative motifs which, while thoroughly modern in feeling and inspiration, avoid the excesses of the extremely modernistic school. The brilliant hanging lamps in the lobby of the New York Telephone Building, the striking ceiling, with its opulent Chinese motif in the San Francisco building, the wood panels, lamps and furniture in the executive offices and directors' room of the building at Newark, may be mentioned as examples of a restrained modernism in decoration. The telephone industry is a relatively young business, a

large proportion of the telephone employees are young, and it is appropriate that the decorative technique which appeals to discriminating present-day taste should be employed in the embellishment of telephone buildings.

#### SOLIDITY

Nor does such a decorative scheme preclude the attainment of an effect of solidity befitting an institution of such stability as the Bell Telephone System. Architects and builders know, and the casual observer discerns, that substantial and durable construction is a characteristic feature of Bell System buildings. There is no jerry-building here. Soundness and durability are essentials that are rigidly required.

#### FORESIGHT

A closely related feature of telephone construction is the provision for future requirements which is made possible by informed forethought. As a general rule, new buildings are planned to provide for the telephone needs in their localities over a period of about eight years, although this is subject to variation to meet specific conditions. If provision were made for the needs of the very remote future, heavy carrying charges would have to be paid on account of excess space provided. On the other hand, if the building were adequate only for immediate needs, there would be risk of the service being impaired and excessive building costs being incurred due to frequent alterations and enlargements of the premises. Eight years is believed to represent a sound balance between these alternatives.

Most of the telephone buildings, except the very largest and the smallest ones, are so constructed as to permit of future extension upward. Foundations and framework are built to carry the weight of additional stories if and when required. In addition, several of the larger buildings—at San Francisco, at Newark, the



ADMINISTRATION BUILDING OF THE OHIO BELL TELEPHONE CO., CLEVELAND, O.



1. LAWDALE CENTRAL OFFICE, COLUMBUS, O. 2. TELEPHONE BUILDING, SPRINGFIELD, O.



Telephone and Telegraph Building at 195 Broadway, New York, and others—are so designed as to permit of later additions on adjoining lots. For the general run of telephone buildings, it is possible to estimate probable future requirements over a period of from eighteen to twenty years. In the past telephone growth has moved forward so rapidly as to prove such forecasts quite conservative. And, of course, it is to be kept in mind that most buildings have a useful life of considerably more than twenty years.

#### BUILDINGS THAT REFLECT A BUSINESS PERSONALITY

Insofar as these qualities of utility, beauty, appropriateness, modernity, solidity and forethought do characterize the telephone buildings, these buildings faithfully mirror the ideals—the personality, if you will—of the Bell System. They are indispensable instrumentalities used in the work of rendering service. But they are also an earnest of the System's realization and intention faithfully to meet the obligations which rest upon it. They are tangible evidence of the thought and effort and care that are being put into the work of furnishing “a telephone service for the nation more and more free from imperfections, errors or delays, and always at a cost as low as is consistent with financial safety.”

They are evidences, too, of the recognition by the Bell System of its duty to provide the telephone workers with healthful, comfortable and convenient places in which to work. Cafeterias, rest-rooms, medical offices, and auditoriums for employee gatherings serve a purpose more far-reaching than merely catering to the needs of telephone workers. They are elements in the Bell System personnel policy which “recognizes its responsibilities to its employees” and aims “to pay salaries and wages in all respects adequate and just and to make sure that individual merit is discovered and recognized.”

Adequate provision for housing Bell System equipment and workers is also, of course, an essential factor in making possible earnings "sufficient to assure the best possible telephone service at all times and to insure the continued financial integrity of the business." Intelligent forethought in providing for future requirements is all-important in the interest of those who have invested their savings in Bell System securities as well as in the interest of the telephone users; and perhaps in no phase of telephone activity is forethought more strikingly exemplified than in the building program, past and present, of the Bell System.

Not only do the telephone buildings express the Bell System's sense of its three-fold obligation to the telephone users, the telephone employees and the telephone investors, but in a larger sense they express the System's realization of its fundamental obligation to the country as a whole, which includes customers, employees, investors and the public at large. For the Bell System is an American institution, and these telephone buildings are expressive of the best in the modern American spirit.

#### EXPRESSING THE MODERN AMERICAN SPIRIT

Comfort, convenience, beauty, the conquest of the forces of nature for the service of mankind—all characteristic of the present age—find expression in these practical monuments dedicated to the service of electrical communication. Business buildings, such as these, are as truly representative of America's present-day spirit as were the Gothic cathedrals of the mediæval age that reared them. Such constructive genius as was devoted to the erection of the castles, palaces, and cathedrals of Europe has not died out with the lapse of the conditions and *Zeitgeist* that gave them birth. In modern America it finds expression in new forms more suited to the demands of the modern spirit, espe-

cially in buildings devoted to public service through the medium of business enterprise.

Telephone buildings are, broadly speaking, public buildings, as truly as any City Hall or Public Library. They exist for the service of the public and it is the public's extensive use of that service which makes them necessary. The public has an interest in them; and public taste is not unresponsive to the inspiring and formative influence which such buildings exert. In many a community the newer telephone buildings appeal notably to civic pride. Citizens are proud to point to a structure which they justly feel is an ornament to the municipality as the home of their telephone organization.

#### TELEPHONE BUILDINGS AS OBJECTS OF CIVIC PRIDE

Shortly after its completion, the New York Telephone Building was honored by the Broadway Association with the presentation of a bronze plaque inscribed "In Recognition of Its Contribution to Civic Advancement Through the Erection of this Great Building, this Tablet is presented to the New York Telephone Company by the Broadway Association of the City of New York, MDCDXXVII."

Joseph Pennell, certainly an exacting critic, called this same structure "the most impressive modern building in the world." He made etchings of it in three different stages of construction. "... the most overpowering building, giving an impression of sheer might," he called it, and again: "the giant bursts upon you, soaring above the low buildings around it." Summing up, he said: "Come back and study it from other streets that surround it. Thus you will learn that great things are being done in the city, after all—far greater than mere prigs from classical dictionaries and histories and postcards of foreign monuments."

Of the same building Fiske Kimball, writing in *The Forum* said: "Trivial reminiscences of the Gothic have

fallen away; puerile suggestions of historic style no longer mar the interior. As in the best German work, all is smelted anew in the creative spirit."

The San Francisco Telephone Building has likewise called forth commendation from artistic critics. Arthur Matthews of Berkley, the well-known mural painter, said of it, in an interview reported in the *San Francisco Call*: "To my mind the most successful office building in San Francisco is the new telephone building on New Montgomery Street. There we have the American skyscraper as a distinct new type with no attempt to stick heavy columns and such devices on top of it in imitation of something else, with nothing to support and no excuses for being."

Writing in the *Pacific Coast Architect*, Harris Allen said of this same structure: "From near and far, from the water which surrounds the city and from the hills which dot its area, the profile of the Telephone Building adds its monumental accent to the mass profile of San Francisco—and this, perhaps, is what gives us most reason for praising its creators." He called the building "a thing of beauty . . . a surprising combination of massive strength and airy grace."

Another Bell System building that has attracted much favorable comment from architectural authorities is the headquarters of the American Telephone and Telegraph Company in New York. The first section of this building was erected some years ago and an addition nearly as large was more recently erected in strict conformity to the design of the original. This design differs materially from the set-back style which characterizes the San Francisco, New York Telephone and other large telephone buildings of recent construction. The headquarters of the whole Bell System is thoroughly Greek in inspiration, and simplicity of line is perhaps the dominant motif in its impressive white facades.

It is the lobby, however, that in this building most





1. MOUNTAIN STATES TELEPHONE CO. HEADQUARTERS, DENVER, COLO. 2. TELEPHONE BUILDING, BURLINGAME, CALIF. 3. UNATTENDED TELEPHONE BUILDING, ARCADIA, CALIF. 4. TELEPHONE BUILDING, HUNTINGTON, N. Y.



TELEPHONE BUILDINGS IN RESIDENTIAL AREAS: 1. SILVER SPRING, MD. 2. SCITUATE, MASS. 3. SCARSDALE, N. Y. 4. VENTURA, CALIF.

impresses the casual visitor. "A Greek hypostyle hall," Kenneth Clark called it in an article in the *Architectural Record*, "possessing in size and scale some of the impressiveness that the Egyptian Temples must have had with their forests of columns and the vistas of dignity and grandeur between them." He added that: "To realize the true scale of this hall it should be seen at night; the play of light on the highly polished walls and columns is very interesting and the 'bigness' of the scheme is apparent, especially if one sees, at the end of one of the long vistas, a figure passing. Then the columns assume their true proportions, by contrast, for . . . they seem almost overpowering, owing to their number and the scale, which in this interior seems greater than in any other modern example. The whole impression created is one of simple richness and dignity, punctuated with the beauty of detail that ornaments the work."

#### SOME DETAILS THAT EPITOMIZE THE SPIRIT OF THE WHOLE

Time would fail to recount the architectural and decorative details even of this one building alone, not to mention those of the other notable Bell System structures. Yet mention may be made of some few items which, in some sense, epitomize the spirit of the whole.

Atop a pyramid surmounting one section of the Telephone and Telegraph Building stands a gilded bronze figure of heroic size representing the "Genius of Electricity" by Evelyn Beatrice Longman, an impersonation, so to speak, of the technical element in the telephone business.

In the Grecian lobby below is a sculptured group in bronze and marble dynamically expressive of "Service to the Nation in Peace and War." The heroic male figure of Service stands before the flag, calling and



sending forth the power of the nation. Above the bronze are marble figures representing the messages of peace and war as they speed along the wires that span the United States. *The Architect* said of this group: "It is refreshing to feel that our great corporations appreciate the value of turning to our best artists for works of this sort . . . which, by their abstract beauty and inspiration, really underlie all successful business." It is fitting that the center of telephone activities should be distinguished with representations of Electricity and of Service.

In certain of the Bell System buildings there have been enshrined stands of battle-flags borne by the Bell Battalions in the World War, a silent reminder of the call to arms which drew so many telephone workers to the colors in 1917-1918, and of the invaluable services that they were able to render, especially in matters of military communication. Those who gave their lives in the War are commemorated in memorial tablets in several of the buildings; and other tablets honor those who in time of peace have won the coveted national awards of gold and silver Theodore N. Vail Medals for Noteworthy Public Service. Such reminders cannot but aid in perpetuating those traditions of the service established by the men and women of the Bell System who have met emergencies with courage and resource.

In the Newark building especial honor has been paid to the memory of Mr. Vail, after whom the auditorium has been named Vail Hall. A tablet in the hall contains a bas-relief of Mr. Vail with an inscription which recalls that his "vision, courage and energy are an inspiration to all Bell Telephone workers."

This inspiration is unquestionably one of the elements in formulating the intangible spirit, the aim, the ideal, the aspiration, which characterizes the Bell System and which is represented in the thousands of buildings, great and small, over which the blue flag of the System is displayed. It is a spirit of which telephone



workers are justly proud; and it is worthily reflected in the buildings in which they work. It might be said of these telephone buildings, as President Hoover said of the Government buildings in Washington: "In architecture it is the spiritual impulse that counts. These buildings should express the ideals and standards of our times; they will be the measure of our skill and taste by which we shall be judged by our children's children. . . . There is need of a daily inspiration of surroundings that suggest not only the traditions of the past, but the greatness of the future."

RICHARD STORRS COE.

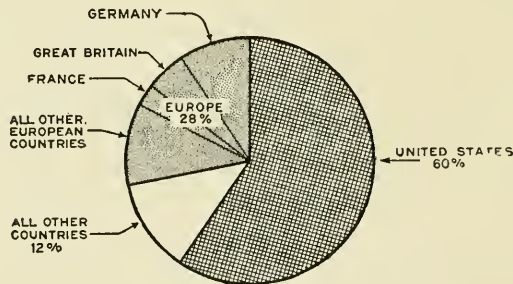
# World's Telephone Statistics

January 1, 1928

IN view of the rapid extension of commercial radio telephone service between the Eastern and Western Hemispheres, statistics regarding the telephone development of the various countries of the world have an added significance. Figures compiled as a result of the annual survey conducted by the Chief Statistician's Division of the American Telephone and Telegraph Company show that on January 1, 1928, the total number of telephones in the world was 30,990,304. Of these telephones, 18,522,767, or 59.8 per cent, were in the United States. Europe on that date had 8,623,-

## DISTRIBUTION OF THE WORLD'S TELEPHONES

— January 1, 1928 —

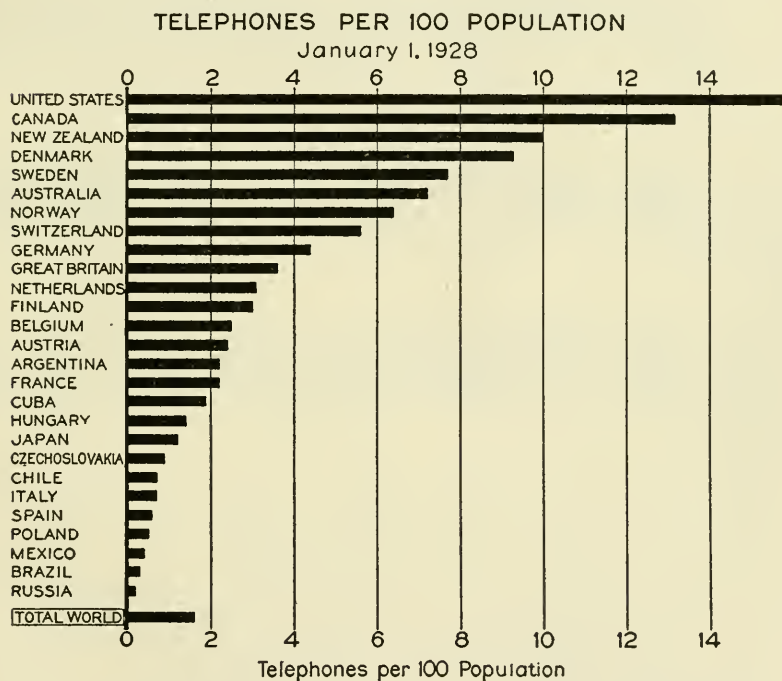


407 telephones, or 27.8 per cent of the world's total, while the remaining countries, comprising all those in Asia, Africa, Oceania and the entire Western Hemisphere outside of the United States, had 3,844,130 telephones, or 12.4 per cent of the total number.

The accompanying tables and charts are based on authoritative data received through correspondence with officials of foreign telephone systems and are reproduced from a printed pamphlet entitled, "Telephone and Telegraph Statistics of the World, January 1, 1928."

COMPARATIVE TELEPHONE DEVELOPMENT OF COUNTRIES

Referring to the table "Telephone Development of the World, by Countries," it is evident that the United States, with 15.8 telephones for each 100 of its people, leads the world both in absolute number of telephones and in relative telephone development. There were in the United States nearly 10 times as many telephones per 100 population as there were in Europe or in the world as a whole. Second in point of development is Canada, with 13.2 telephones per 100 inhabitants; then follow in order, New Zealand with 10.0, Denmark with 9.3, Sweden with 7.7, and Australia with 7.2 telephones per 100 population. In the United States all of the



telephones are operated by private companies, while 82 per cent of the total telephones in Canada, and 96 per cent of those in Denmark, are also under private ownership and operation. Adding to these the tele-

# TELEPHONE DEVELOPMENT OF THE WORLD, BY COUNTRIES January 1, 1928

|                                        | Number of Telephones  |                      | Total      | Per Cent<br>of Total<br>World | Telephones<br>per 100<br>Population | Increase in<br>Number of<br>Telephones<br>During 1927 |
|----------------------------------------|-----------------------|----------------------|------------|-------------------------------|-------------------------------------|-------------------------------------------------------|
|                                        | Government<br>Systems | Private<br>Companies |            |                               |                                     |                                                       |
| <b>NORTH AMERICA:</b>                  |                       |                      |            |                               |                                     |                                                       |
| United States.....                     | .....                 | 18,522,767           | 18,522,767 | 59.77%                        | 15.8                                | 776,599                                               |
| Canada.....                            | 226,673               | 1,033,314            | 1,259,987  | 4.07%                         | 13.2                                | 58,979                                                |
| Central America.....                   | 9,682                 | 12,829               | 22,511     | .07%                          | 0.3                                 | 2,228                                                 |
| Mexico.....                            | 1,427                 | 63,489               | 64,916     | .21%                          | 0.4                                 | 7,353                                                 |
| <b>West Indies:</b>                    |                       |                      |            |                               |                                     |                                                       |
| Cuba.....                              | 491                   | 68,337               | 68,828     | .22%                          | 1.9                                 | 3,612                                                 |
| Porto Rico.....                        | 820                   | 12,402               | 13,222     | .04%                          | 0.9                                 | —152                                                  |
| Other W. I. Places *.....              | 7,790                 | 10,583               | 18,373     | .06%                          | 0.3                                 | 213                                                   |
| Other No. Am. Places *.....            | 100                   | 8,900                | 9,000      | .03%                          | 2.6                                 | 500                                                   |
| Total.....                             | 246,983               | 19,732,621           | 19,979,604 | 64.47%                        | 12.5                                | 849,332                                               |
| <b>EUROPE:</b>                         |                       |                      |            |                               |                                     |                                                       |
| Austria.....                           | 165,231               | .....                | 165,231    | .53%                          | 2.4                                 | 6,802                                                 |
| Belgium.....                           | 196,691               | .....                | 196,691    | .63%                          | 2.5                                 | 20,119                                                |
| Bulgaria.....                          | 14,358                | .....                | 14,358     | .05%                          | 0.3                                 | 4,348                                                 |
| Czechoslovakia.....                    | 122,277               | 11,846               | 134,123    | .43%                          | 0.9                                 | 5,167                                                 |
| Denmark.....                           | 13,040†               | 311,192              | 324,232    | 1.05%                         | 9.3                                 | 3,123                                                 |
| Finland.....                           | 973                   | 108,000              | 108,973    | .35%                          | 3.0                                 | 20,417                                                |
| France.....                            | 883,406               | .....                | 883,406    | 2.85%                         | 2.2                                 | 60,536                                                |
| Germany.....                           | 2,814,996             | .....                | 2,814,996  | 9.08%                         | 4.4                                 | 126,501                                               |
| Great Britain and No. Ireland.....     | 1,633,802             | .....                | 1,633,802  | 5.27%                         | 3.6                                 | 122,217                                               |
| Greece.....                            | 8,000                 | .....                | 8,000      | .03%                          | 0.1                                 | 1,672                                                 |
| Hungary.....                           | 120,000               | .....                | 120,000    | .39%                          | 1.4                                 | 5,000                                                 |
| Irish Free State (March 31, 1928)..... | 25,317                | .....                | 25,317     | .08%                          | 0.8                                 | 1,487                                                 |
| Italy (June 30, 1928).....             | .....                 | 292,867              | 292,867    | .95%                          | 0.7                                 | 20,434                                                |
| Jugo-Slavia.....                       | 31,393                | .....                | 31,393     | .10%                          | 0.2                                 | 3,015                                                 |
| Latvia (March 31, 1928).....           | 29,165                | .....                | 29,165     | .09%                          | 1.2                                 | 4,973                                                 |
| Netherlands.....                       | 238,602               | .....                | 238,602    | .77%                          | 3.1                                 | 13,254                                                |
| Norway.....                            | 104,480†              | 75,004               | 179,484    | .58%                          | 6.4                                 | 3,984                                                 |
| Poland.....                            | 93,590                | 63,835               | 157,425    | .51%                          | 0.5                                 | 25,474                                                |
| Portugal.....                          | 3,000*                | 21,127               | 24,127     | .08%                          | 0.4                                 | 1,677                                                 |
| Roumania.....                          | 56,024                | .....                | 56,024     | .18%                          | 0.3                                 | 2,750                                                 |
| Russia§.....                           | 260,000               | .....                | 260,000    | .84%                          | 0.2                                 | 20,000                                                |
| Spain.....                             | .....                 | 141,214              | 141,214    | .46%                          | 0.6                                 | 9,695                                                 |
| Sweden.....                            | 465,132               | 1,655                | 466,787    | 1.51%                         | 7.7                                 | 16,141                                                |
| Switzerland.....                       | 223,597               | .....                | 223,597    | .72%                          | 5.6                                 | 13,111                                                |
| Other Places in Europe*.....           | 75,134                | 18,459               | 93,593     | .30%                          | 1.1                                 | 4,000                                                 |
| Total.....                             | 7,578,208             | 1,045,199            | 8,623,407  | 27.83%                        | 1.6                                 | 515,997                                               |



# SOUTH AMERICA:

|                                     |           |            |         |      |           |
|-------------------------------------|-----------|------------|---------|------|-----------|
| Argentina.....                      | 232,041   | 232,041    | .75%    | 2.2  | 27,578    |
| Bolivia.....                        | 2,612     | 2,612      | .01%    | 0.1  | 788       |
| Brazil.....                         | 636       | 108,189    | .35%    | 0.3  | 2,980     |
| Chile.....                          | 50        | 38,573     | .13%    | 0.7  | 1,713     |
| Colombia.....                       | 21,060    | 21,110     | .07%    | 0.3  | 2,235     |
| Ecuador.....                        | 1,442     | 4,407      | .01%    | 0.2  | —111      |
| Paraguay.....                       | 183       | 230        | .001%   | 0.03 | .....     |
| Peru.....                           | 13,695    | 13,695     | .04%    | 0.2  | 466       |
| Uruguay.....                        | 26,934    | 26,934     | .09%    | 1.5  | 19        |
| Venezuela.....                      | 641       | 13,098     | .04%    | 0.4  | 366       |
| Other Places.....                   | 2,738     | 2,738      | .01%    | 0.6  | 30        |
| Total.....                          | 5,690     | 463,810    | 1.50%   | 0.6  | 36,064    |
| ASIA:                               |           |            |         |      |           |
| British India (March 31, 1928)..... | 19,955    | 51,838     | .17%    | 0.02 | 5,940     |
| China*.....                         | 80,000    | 130,000    | .42%    | 0.03 | 5,000     |
| Japan (March 31, 1928).....         | 750,561   | 750,561    | 2.42%   | 1.2  | 102,470   |
| Other Places in Asia*.....          | 95,000    | 110,000    | .35%    | 0.1  | 1,000     |
| Total.....                          | 945,516   | 1,042,399  | 3.36%   | 0.1  | 114,410   |
| AFRICA:                             |           |            |         |      |           |
| Egypt.....                          | 40,102    | 40,102     | .13%    | 0.2  | 2,397     |
| Union of South Africa*.....         | 97,155    | 97,155     | .31%    | 1.3  | 6,500     |
| Other Places in Africa*.....        | 65,000    | 66,100     | .21%    | 0.1  | 6,000     |
| Total.....                          | 202,257   | 203,357    | .65%    | 0.1  | 14,897    |
| OCEANIA:                            |           |            |         |      |           |
| Australia (June 30, 1927).....      | 442,362   | 442,362    | 1.43%   | 7.2  | 38,746    |
| Dutch East Indies.....              | 42,068    | 45,998     | .15%    | 0.1  | 3,099     |
| Hawaii.....                         | .....     | 21,441     | .07%    | 7.0  | 1,793     |
| New Zealand (March 31, 1928).....   | 144,552   | 144,552    | .47%    | 10.0 | 7,245     |
| Philippine Islands.....             | 5,135     | 19,874     | .06%    | 0.2  | 2,060     |
| Other Places in Oceania*.....       | 2,900     | 3,500      | .01%    | 0.2  | 200       |
| Total.....                          | 637,017   | 677,727    | 2.19%   | 0.9  | 53,143    |
| TOTAL WORLD.....                    | 9,615,671 | 30,990,304 | 100.00% | 1.6  | 1,583,743 |

\* Partly estimated.

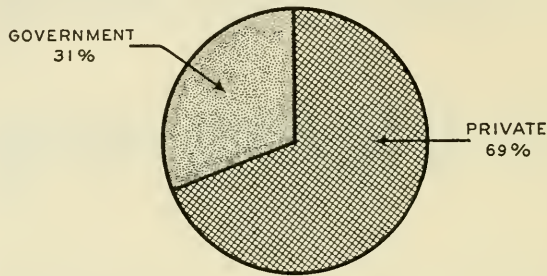
† March 31, 1928.

‡ June 30, 1927.

§ U.S.S.R., including Siberia and Associated Republics; partly estimated.

phones of other private systems in various countries, 69 per cent of the total telephones in the world are classified under private ownership, as is indicated by the chart, "Ownership of the World's Telephones." In point of absolute number of telephones, Germany is second to the United States, but that country had only 4.4 telephones per 100 of its population, which is

OWNERSHIP OF THE WORLD'S TELEPHONES  
January 1, 1928



only about one-quarter of the telephone density in the United States. Despite its comparatively low development, Germany, however, exceeded Great Britain and France in this respect by a considerable margin. The best developed country in South America is Argentina, with 2.2 telephones per 100 population. In Asia, Japan leads all other countries, but had a development of only 1.2 telephones per 100 inhabitants.

During the year 1927, the number of telephones throughout the world increased by 1,583,743. Of this increase, 776,599, or about one-half, were added in the United States. There were 515,897 telephones added to all the European systems combined, which is only two-thirds of the increase in the United States. Germany increased its telephones by 126,501, Great Britain by 122,217. In spite of the fact that France has a development of only 2.2 telephones per 100 people, only 60,536 telephones were added to the French system during 1927.

# TELEPHONE DEVELOPMENT OF LARGE AND SMALL COMMUNITIES January 1, 1928

| Country                        | Service<br>Operated<br>(See Note) | Number of Telephones                                  |                                                        | Telephones per 100 Population                         |                                                        |
|--------------------------------|-----------------------------------|-------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|
|                                |                                   | In Communities<br>of 50,000<br>Population<br>and Over | In Communities<br>of less than<br>50,000<br>Population | In Communities<br>of 50,000<br>Population<br>and Over | In Communities<br>of less than<br>50,000<br>Population |
| Australia (June 30, 1927)*     | G.                                | 249,481                                               | 192,881                                                | 8.6                                                   | 5.9                                                    |
| Belgium                        | G.                                | 143,377                                               | 53,314                                                 | 4.5                                                   | 1.1                                                    |
| Canada                         | P. G.                             | 608,300                                               | 651,687                                                | 22.0                                                  | 9.6                                                    |
| Czechoslovakia                 | P. G.                             | 55,637                                                | 78,486                                                 | 4.0                                                   | 0.6                                                    |
| Denmark                        | P. G.                             | 144,149                                               | 180,083                                                | 15.9                                                  | 6.9                                                    |
| France                         | G.                                | 522,962                                               | 360,444                                                | 6.0                                                   | 1.1                                                    |
| Germany                        | G.                                | 1,722,644                                             | 1,092,352                                              | 8.3                                                   | 2.6                                                    |
| Great Britain and No. Ireland† | G.                                | 1,198,282                                             | 468,056                                                | 5.0                                                   | 2.1                                                    |
| Japan (March 31, 1928)         | G.                                | 446,284                                               | 304,277                                                | 3.6                                                   | 0.6                                                    |
| Netherlands                    | G.                                | 153,782                                               | 84,820                                                 | 5.6                                                   | 1.7                                                    |
| New Zealand (March 31, 1928)   | G.                                | 53,589                                                | 90,963                                                 | 9.9                                                   | 10.0                                                   |
| Norway                         | P. G.                             | 59,327                                                | 120,157                                                | 14.6                                                  | 5.0                                                    |
| Poland                         | P. G.                             | 77,357                                                | 80,068                                                 | 2.5                                                   | 0.3                                                    |
| Sweden                         | G.                                | 183,511                                               | 283,276                                                | 19.7†                                                 | 5.5                                                    |
| Switzerland                    | G.                                | 94,147                                                | 129,450                                                | 11.9                                                  | 4.0                                                    |
| United States                  | P.                                | 9,872,144                                             | 8,650,623                                              | 21.2                                                  | 12.2                                                   |

Note: P. indicates telephone service operated by private companies, G. by the Government, and P. G. by both private companies and the Government.

\* Partly estimated.

† March 31, 1928.

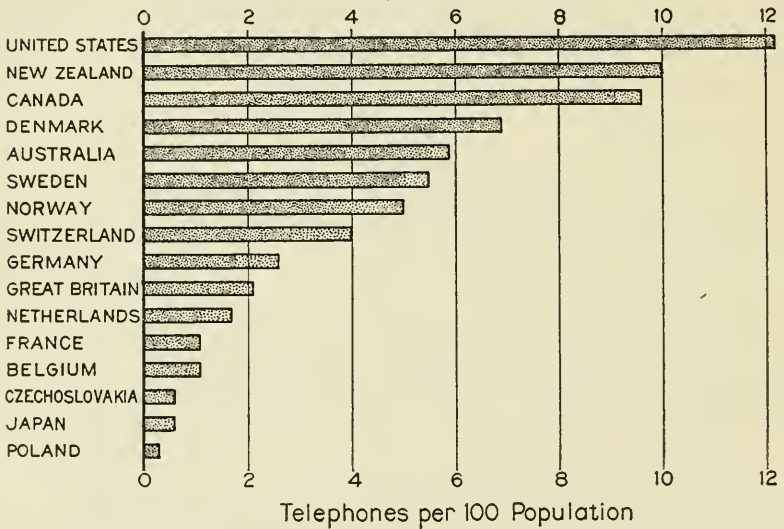
‡ The majority of this development is due to Stockholm.

TELEPHONES IN LARGE AND SMALL COMMUNITIES

The table "Telephone Development of Large and Small Communities" is of special interest in that it indicates the extent to which telephone service is made available to the smaller communities in the principal countries. Here again, the United States is well ahead in providing telephone facilities in the less populated sections. In fact, its development of 12.2 telephones per 100 inhabitants in communities of less than 50,000

TELEPHONES PER 100 POPULATION  
COMMUNITIES LESS THAN 50,000 POPULATION

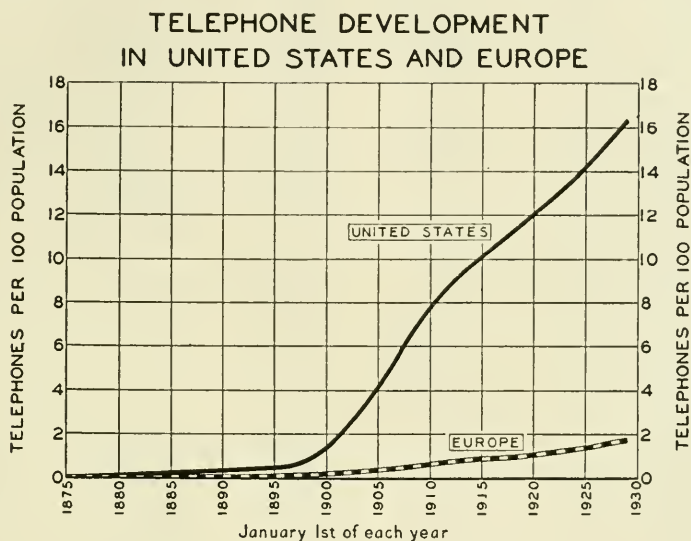
January 1, 1928



population is greater than the *total* telephone density of any other country with the single exception of Canada. New Zealand, with a comparatively small geographical area, had a development of 10.0 telephones per 100 population in communities of less than 50,000 inhabitants. Canada was a close third with 9.6. The comparative superiority of the United States in providing telephone service for its rural sections is strikingly emphasized by the fact that in Germany there



were only 2.6 telephones per 100 population in communities of less than 50,000 people, while the corresponding figures for Great Britain and France were 2.1 and 1.1, respectively. It can be said that with the exception of New Zealand, Canada and the Scandinavian countries, telephone service in foreign countries is still predominantly confined to urban centers.



#### TELEPHONES IN LARGE CITIES

London, on March 31, 1928, had 578,322 telephones, or about 35 per cent of the total telephones in Great Britain; the four cities of Berlin, Hamburg-Altona, Leipzig and Munich had a total of 734,445 telephones, or about 26 per cent of all the telephones in Germany; Paris alone had 36 per cent of the total telephones in France. New York City, however, had less than 9 per cent of the total telephones in the United States, which further emphasizes the degree of concentration of European telephones in larger cities.

From the standpoint of development, San Francisco, with 32.8 telephones per 100 population on January 1, 1928, led the principal cities of the world shown

# TELEPHONE DEVELOPMENT OF LARGE CITIES

January 1, 1923

| Country and City<br>(or Exchange Area) | Estimated<br>Population<br>(City or Exchange<br>Area) | Number of<br>Telephones | Telephones<br>per 100<br>Population |
|----------------------------------------|-------------------------------------------------------|-------------------------|-------------------------------------|
| ARGENTINA:                             |                                                       |                         |                                     |
| Buenos Aires . . . . .                 | 2,031,000                                             | 129,503                 | 6.4                                 |
| AUSTRALIA:                             |                                                       |                         |                                     |
| Adelaide . . . . .                     | 328,000                                               | 29,517                  | 9.0                                 |
| Brisbane . . . . .                     | 295,000                                               | 21,701                  | 7.4                                 |
| Melbourne . . . . .                    | 975,000                                               | 85,884                  | 8.8                                 |
| Sydney . . . . .                       | 1,101,000                                             | 103,254                 | 9.4                                 |
| AUSTRIA:                               |                                                       |                         |                                     |
| Vienna . . . . .                       | 1,957,000                                             | 105,420                 | 5.4                                 |
| BELGIUM:                               |                                                       |                         |                                     |
| Antwerp . . . . .                      | 505,000                                               | 28,131                  | 5.6                                 |
| Brussels . . . . .                     | 913,000                                               | 67,505                  | 7.4                                 |
| Ghent . . . . .                        | 260,000                                               | 8,067                   | 3.1                                 |
| Liege . . . . .                        | 415,000                                               | 13,521                  | 3.3                                 |
| CANADA:                                |                                                       |                         |                                     |
| Montreal . . . . .                     | 880,000                                               | 161,380                 | 18.3                                |
| Ottawa . . . . .                       | 178,000                                               | 35,252                  | 19.8                                |
| Toronto . . . . .                      | 657,000                                               | 173,264                 | 26.4                                |
| CHINA:                                 |                                                       |                         |                                     |
| Canton . . . . .                       | 943,000                                               | 2,475                   | 0.3                                 |
| Shanghai . . . . .                     | 1,600,000                                             | 27,217                  | 1.7                                 |
| Tientsin . . . . .                     | 846,000                                               | 9,085                   | 1.1                                 |
| Peking . . . . .                       | 1,350,000                                             | 29,857                  | 2.2                                 |
| CUBA:                                  |                                                       |                         |                                     |
| Havana . . . . .                       | 581,000                                               | 46,998                  | 8.1                                 |
| CZECHOSLOVAKIA:                        |                                                       |                         |                                     |
| Prague . . . . .                       | 718,000                                               | 32,465                  | 4.5                                 |
| DANZIG, FREE CITY OF . . . . .         | 390,000                                               | 17,508                  | 4.5                                 |
| DENMARK:                               |                                                       |                         |                                     |
| Copenhagen . . . . .                   | 775,000                                               | 126,849                 | 16.4                                |
| FINLAND:                               |                                                       |                         |                                     |
| Helsingfors . . . . .                  | 218,000                                               | 25,674                  | 11.8                                |
| FRANCE:                                |                                                       |                         |                                     |
| Bordeaux . . . . .                     | 258,000                                               | 13,976                  | 5.4                                 |
| Lille . . . . .                        | 204,000                                               | 12,212                  | 6.0                                 |
| Lyons . . . . .                        | 576,000                                               | 21,487                  | 3.7                                 |
| Marseilles . . . . .                   | 659,000                                               | 21,128                  | 3.2                                 |
| Paris . . . . .                        | 2,900,000                                             | 314,541                 | 10.8                                |
| GERMANY:                               |                                                       |                         |                                     |
| Berlin . . . . .                       | 4,105,000                                             | 448,030                 | 10.9                                |
| Bremen . . . . .                       | 300,000                                               | 29,610                  | 9.9                                 |
| Breslau . . . . .                      | 569,000                                               | 39,619                  | 7.0                                 |
| Chemnitz . . . . .                     | 338,000                                               | 25,121                  | 7.4                                 |
| Cologne . . . . .                      | 714,000                                               | 61,682                  | 8.6                                 |
| Dresden . . . . .                      | 631,000                                               | 55,431                  | 8.8                                 |
| Dusseldorf . . . . .                   | 441,000                                               | 40,496                  | 9.2                                 |
| Essen . . . . .                        | 481,000                                               | 24,846                  | 5.2                                 |
| Frankfort-on-Main . . . . .            | 477,000                                               | 54,416                  | 11.4                                |
| Hamburg-Altona . . . . .               | 1,290,000                                             | 157,710                 | 12.2                                |
| Hannover . . . . .                     | 431,000                                               | 33,262                  | 7.7                                 |
| Leipzig . . . . .                      | 693,000                                               | 62,309                  | 9.0                                 |
| Magdeburg . . . . .                    | 300,000                                               | 20,139                  | 6.7                                 |
| Munich . . . . .                       | 707,000                                               | 66,396                  | 9.4                                 |
| Nuremburg . . . . .                    | 475,000                                               | 32,582                  | 6.9                                 |
| Stuttgart . . . . .                    | 348,000                                               | 38,839                  | 11.2                                |
| GREAT BRITAIN AND NO. IRELAND:*        |                                                       |                         |                                     |
| Belfast . . . . .                      | 421,000                                               | 13,623                  | 3.2                                 |
| Birmingham . . . . .                   | 1,085,000                                             | 43,699                  | 4.0                                 |
| Blackburn . . . . .                    | 129,000                                               | 3,896                   | 3.0                                 |
| Bolton . . . . .                       | 182,000                                               | 5,102                   | 2.8                                 |
| Bradford . . . . .                     | 319,000                                               | 16,565                  | 5.2                                 |
| Bristol . . . . .                      | 396,000                                               | 15,760                  | 4.0                                 |
| Edinburgh . . . . .                    | 426,000                                               | 24,153                  | 5.7                                 |
| Glasgow . . . . .                      | 1,136,000                                             | 51,026                  | 4.5                                 |
| Hull . . . . .                         | 347,000                                               | 15,497                  | 4.5                                 |
| Leeds . . . . .                        | 489,000                                               | 18,955                  | 3.9                                 |
| Liverpool . . . . .                    | 1,133,000                                             | 51,591                  | 4.6                                 |
| London . . . . .                       | 7,520,000                                             | 578,322                 | 7.7                                 |
| Manchester . . . . .                   | 1,070,000                                             | 55,255                  | 5.2                                 |
| Newcastle . . . . .                    | 465,000                                               | 16,947                  | 3.6                                 |
| Nottingham . . . . .                   | 297,000                                               | 13,311                  | 4.5                                 |
| Plymouth . . . . .                     | 213,000                                               | 5,701                   | 2.7                                 |
| Sheffield . . . . .                    | 498,000                                               | 16,525                  | 3.3                                 |

\* March 31, 1923.

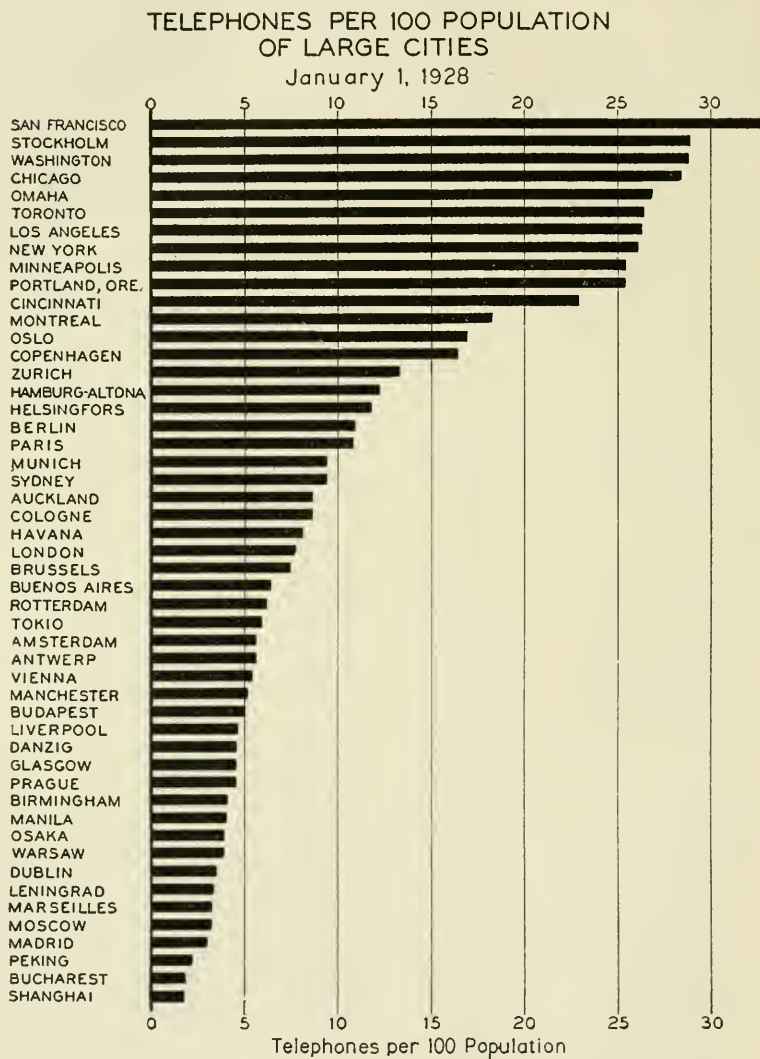
# TELEPHONE DEVELOPMENT OF LARGE CITIES—(Concluded)

January 1, 1928

| Country and City<br>(or Exchange Area)                           | Estimated<br>Population<br>(City or Exchange<br>Area) | Number of<br>Telephones | Telephones<br>per 100<br>Population |
|------------------------------------------------------------------|-------------------------------------------------------|-------------------------|-------------------------------------|
| <b>HUNGARY (January 1, 1927):</b>                                |                                                       |                         |                                     |
| Budapest.....                                                    | 985,000                                               | 49,120                  | 5.0                                 |
| Szegedin.....                                                    | 126,000                                               | 2,359                   | 1.9                                 |
| <b>IRISH FREE STATE (March 31, 1927):</b>                        |                                                       |                         |                                     |
| Dublin.....                                                      | 400,000                                               | 14,032                  | 3.5                                 |
| <b>ITALY (January 1, 1929):</b>                                  |                                                       |                         |                                     |
| Milan.....                                                       | 831,000                                               | 56,315                  | 6.8                                 |
| Rome.....                                                        | 771,000                                               | 32,528                  | 4.2                                 |
| <b>JAPAN (March 31, 1928):</b>                                   |                                                       |                         |                                     |
| Kobe.....                                                        | 667,000                                               | 25,581                  | 3.8                                 |
| Kyoto.....                                                       | 736,000                                               | 31,166                  | 4.2                                 |
| Nagoya.....                                                      | 870,000                                               | 26,007                  | 3.0                                 |
| Osaka.....                                                       | 2,334,000                                             | 90,744                  | 3.9                                 |
| Tokio.....                                                       | 2,218,000                                             | 129,548                 | 5.8                                 |
| Yokohama.....                                                    | 537,000                                               | 13,398                  | 2.5                                 |
| <b>LATVIA (March 31, 1927):</b>                                  |                                                       |                         |                                     |
| Riga.....                                                        | 343,000                                               | 11,215                  | 3.3                                 |
| <b>NETHERLANDS:</b>                                              |                                                       |                         |                                     |
| Amsterdam.....                                                   | 735,000                                               | 41,057                  | 5.6                                 |
| The Hague.....                                                   | 445,000                                               | 33,265                  | 7.5                                 |
| Rotterdam.....                                                   | 572,000                                               | 35,643                  | 6.2                                 |
| <b>NEW ZEALAND (March 31, 1928):</b>                             |                                                       |                         |                                     |
| Auckland.....                                                    | 204,000                                               | 17,460                  | 8.6                                 |
| Christchurch.....                                                | 123,000                                               | 11,188                  | 9.1                                 |
| Wellington.....                                                  | 128,000                                               | 17,167                  | 13.4                                |
| <b>NORWAY (June 30, 1927):</b>                                   |                                                       |                         |                                     |
| Oslo.....                                                        | 252,000                                               | 42,609                  | 16.9                                |
| <b>PHILIPPINE ISLANDS:</b>                                       |                                                       |                         |                                     |
| Manila.....                                                      | 338,000                                               | 13,586                  | 4.0                                 |
| <b>POLAND</b>                                                    |                                                       |                         |                                     |
| Warsaw.....                                                      | 1,050,000                                             | 41,163                  | 3.9                                 |
| <b>ROUMANIA:</b>                                                 |                                                       |                         |                                     |
| Bucharest.....                                                   | 808,000                                               | 14,357                  | 1.8                                 |
| <b>RUSSIA (March 31, 1928):</b>                                  |                                                       |                         |                                     |
| Leningrad.....                                                   | 1,630,000                                             | 53,090                  | 3.3                                 |
| Moscow.....                                                      | 2,040,000                                             | 65,350                  | 3.2                                 |
| Odessa.....                                                      | 415,000                                               | 4,167                   | 1.0                                 |
| <b>SPAIN:</b>                                                    |                                                       |                         |                                     |
| Barcelona.....                                                   | 761,000                                               | 21,267                  | 2.8                                 |
| Madrid.....                                                      | 808,000                                               | 23,936                  | 3.0                                 |
| Seville.....                                                     | 216,000                                               | 1,926                   | 0.9                                 |
| Valencia.....                                                    | 268,000                                               | 4,259                   | 1.6                                 |
| <b>SWEDEN:</b>                                                   |                                                       |                         |                                     |
| Göteborg.....                                                    | 233,000                                               | 31,483                  | 13.5                                |
| Malmö.....                                                       | 117,000                                               | 15,875                  | 13.6                                |
| Stockholm.....                                                   | 398,000                                               | 114,923                 | 28.9                                |
| <b>SWITZERLAND:</b>                                              |                                                       |                         |                                     |
| Basel.....                                                       | 143,000                                               | 16,476                  | 11.5                                |
| Berne.....                                                       | 110,000                                               | 13,231                  | 12.0                                |
| Geneva.....                                                      | 127,000                                               | 17,060                  | 13.4                                |
| Zurich.....                                                      | 218,000                                               | 29,077                  | 13.3                                |
| <b>UNITED STATES:†</b>                                           |                                                       |                         |                                     |
| New York.....                                                    | 6,124,000                                             | 1,599,915               | 26.1                                |
| Chicago.....                                                     | 3,185,000                                             | 903,460                 | 28.4                                |
| Los Angeles.....                                                 | 1,270,000                                             | 333,971                 | 26.3                                |
| Total of the 8 cities with over<br>1,000,000 population.....     | 18,170,000                                            | 4,357,886               | 24.0                                |
| San Francisco.....                                               | 730,000                                               | 239,155                 | 32.8                                |
| Cincinnati.....                                                  | 672,000                                               | 154,021                 | 22.9                                |
| Milwaukee.....                                                   | 655,000                                               | 137,303                 | 21.0                                |
| Washington.....                                                  | 512,000                                               | 147,347                 | 28.8                                |
| Total of the 11 cities with 500,-<br>000-1,000,000 population... | 7,363,000                                             | 1,495,708               | 20.3                                |
| Minneapolis.....                                                 | 482,000                                               | 122,279                 | 25.4                                |
| Portland, Ore.....                                               | 366,000                                               | 92,862                  | 25.4                                |
| Seattle.....                                                     | 399,000                                               | 109,645                 | 27.5                                |
| Omaha.....                                                       | 231,000                                               | 62,179                  | 26.9                                |
| Total of the 30 cities with 200,-<br>000-500,000 population....  | 8,831,000                                             | 1,788,069               | 20.2                                |
| Total of the 49 cities with over<br>200,000 population.....      | 34,364,000                                            | 7,641,663               | 22.2                                |

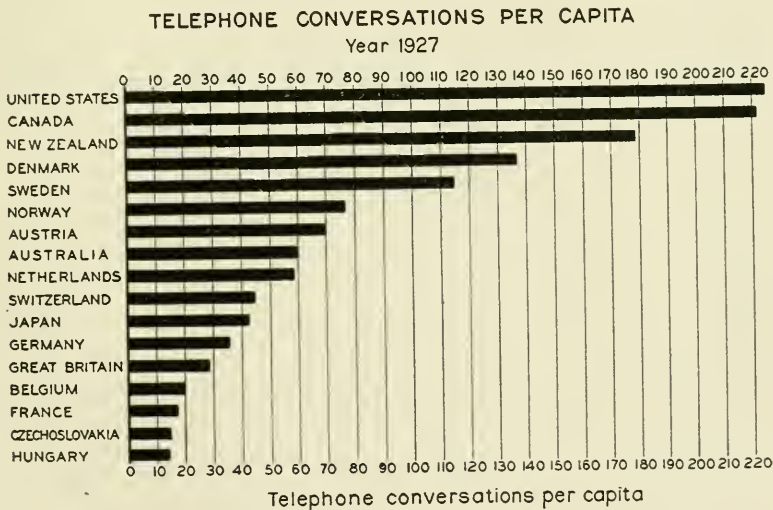
† There are shown, for purposes of comparison with cities in other countries, the total development of all cities in the United States in certain population groups and the development of certain representative cities within each of such groups.

in the table and chart relating to large cities. Stockholm was second, with 28.9 instruments per 100 people. Washington followed Stockholm very closely with 28.8 telephones per 100 population. New York City had 1,599,915 instruments, representing a development of 26.1 for each hundred of its inhabitants. New York City





alone had nearly as many telephones as Great Britain, and more than one-half the number of telephones in Germany. Chicago, with 903,460 instruments, had more telephones than all of France. The eleven large American cities shown in the table had an average development of 26.7 telephones per 100 population. With the exception of Stockholm, Copenhagen, Oslo and Ottawa, no capital city of a foreign country had a development exceeding 15 telephones per 100 population. In fact, only four large cities in Germany, namely, Berlin, Frankfort-on-Main, Hamburg-Altona, and Stuttgart had developments exceeding 10, while Paris, with 10.8 instruments per 100 population, is the only city in France above that mark. Most of the British cities are well below a development of 5 telephones per 100 inhabitants, and London with 7.7, is considerably lower than either Berlin and Paris.



#### COMPARATIVE USE OF THE TELEPHONE

The chart, "Telephone Conversations Per Capita," shows that the United States, with 224.7 conversations per capita in 1927, led the world in the extent to which

its telephone service was used by its people. Canada was second with 221.5 conversations per capita, and New Zealand third with 178.9. Although the Scandinavian countries of Denmark (136.8), Sweden (114.6), and Norway (76.2) were considerably below the United States as regards telephone usage, they were well ahead of the other European countries in this respect. Thus, in Germany telephone conversations per capita were only 35.5 during 1927, while the corresponding figures for Great Britain and France were 28.6 and 17.2, respectively. In other words, the people of the United States make six times more use of their telephone system than the Germans, almost eight times more than the British and thirteen times more than the French.

## Abstracts of Technical Articles From Bell System Sources

*Relation of Nitrogen to Blue Heat Phenomena in Iron and Dispersion-Hardening in the System Iron-Nitrogen,*<sup>1</sup> by R. S. Dean, R. O. Day and J. L. Gregg. It has been generally observed that iron, as an outstanding exception among metals, increases its hardness and strength by low-temperature annealing after cold work, and also by increase of testing temperature to the range of 150° C. to 300° C. This investigation was made with the object of ascertaining if similar phenomena were observed in high purity iron, and, if not, to the presence of which impurities these phenomena could be traced. After describing the tests made and giving the results, the authors come to the conclusion that commercial irons owe their property of hardening by reheating after cold work, as well as their increase in tensile strength in the range 100° C. to 300° C., to the solution of small amounts of iron-nitride present.

*Heat Treatment and Mechanical Properties of Some Copper-zinc and Copper-tin Alloys Containing Nickel and Silicon,*<sup>2</sup> by W. C. Ellis and Earle E. Schumacher. The addition of nickel and silicon to the copper-zinc and copper-tin systems results in alloys which can be hardened by heat treatment. The heat treatment, in general, consists of a quench from 800° C. followed by hardening at 400° C. to 500° C. The dispersion hardening effect of nickel and silicon in these alloys opens a considerable field in the manufacture of high strength brasses. The mechanical properties in the rolled condition of the hardened brass containing 30 per cent of zinc and 3 per cent of nickel plus silicon are in general similar to those of high brass sheet in

<sup>1</sup> Mining and Metallurgy, Vol. 10, March, 1929, p. 163 (abstract).

<sup>2</sup> Mining and Metallurgy, Vol. 10, March, 1929, p. 162 (abstract).

the spring temper. The endurance limit in reversed flexure for this alloy in the hardened condition is, however, approximately 20 per cent higher than that of high brass sheet in the same temper.

*A Metallographic Study of Tungsten Carbide Alloys*,<sup>3</sup> by J. L. Gregg and C. W. Küttner. This paper gives the results of an investigation of the structure of five of the tungsten-carbon alloys by means of microscopic and X-ray methods, the samples studied being small tools or wire-drawing dies. After a general discussion of the constituents of tungsten-carbon alloys, the preparation of the samples is described, and the structures found are shown in twenty-one figures accompanying the text.

*Motion Pictures in Relief*,<sup>4</sup> by Herbert E. Ives. In this article Dr. Ives describes the method by which stereoscopic motion picture projection can, theoretically, at least, be attained. The method is relatively complicated and has severe practical limitations. It appears to be theoretically sound and capable of realization, at least on an experimental scale.

*The Absorption of Oxygen by Rubber*,<sup>5</sup> by G. T. Kohman. The work reported in this paper was planned for the purpose of determining the part played by oxygen absorption in the natural aging of rubber. To do this, the effects of a number of factors known to influence natural aging on rates of oxygen absorption were studied. A piece of apparatus, developed for determining these rates, which involves special means for keeping the oxygen pressure surrounding the sample constant is described. The results obtained lead to the conclusion that oxygen absorption is the predominating factor in the natural aging of rubber and that rates of

<sup>3</sup> Mining and Metallurgy, Vol. 10, February, 1929, p. 94 (abstract).

<sup>4</sup> Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 18, February, 1929, pp. 118-122.

<sup>5</sup> Journal of Physical Chemistry, Vol. 33, February, 1929, pp. 226-243.



oxygen absorption are of value in predicting the natural life of rubber.

*An Electrical Test for Tin Coating on Copper Wire,*<sup>6</sup> by H. M. Larsen and C. M. Underwood. The method described is essentially a deplating process. The wire samples are placed in an acid solution and a current of suitable value applied to effect the deplating. The weight of tin on the wire surface and that alloyed with the copper are determined separately, the measuring means being two graduated tubes containing electrodes (sometimes called voltameters). The gas evolved in these voltameters is proportional to the current and hence to the tin being removed. As soon as the copper surface is exposed, an auxiliary electrode in the deplating bath actuates a relay which brings into operation the second voltameter, permitting determination of the tin alloyed with the copper.

Very simple formulæ permit determining the amount of tin from the volume of gas accumulated in the two voltameters. The method is said to save time and permit the use of relatively unskilled operators as compared with the usual chemical tests applied to tin coatings.

*Further Observations on the Microstructure of Martensite,*<sup>7</sup> by Francis F. Lucas. This paper is a further contribution by Dr. Lucas on the microstructure of martensite. It describes a number of quenching and tempering experiments in which commercial high quality tool steels were used. Representative structures found in the quenched and various tempered conditions are illustrated and discussed.

*Technique of the Talking Movie,*<sup>8</sup> by Donald MacKenzie. In this article the talking movies are de-

<sup>6</sup> Wire & Wire Products, Vol. 4, April, 1929, pp. 118-119, 140.

<sup>7</sup> Transactions of the American Society for Steel Treating, Vol. 15, February, 1929, pp. 339-364.

<sup>8</sup> Journal of the Western Society of Engineers, Vol. 34, February, 1929, pp. 95-102.

scribed in some detail as to mechanical features, production and exhibition. The author tells some interesting things about producing these pictures and the human reactions that must be considered in preparing a picture with sound record so that it will seem natural and the changes that producers will have to make to satisfy the public.

*Some Long Distance Transmission Problems*,<sup>9</sup> by H. Mouradian. This paper discusses the transmission properties of high voltage power transmission lines with incidental reference to telephone transmission. The method of improving the performance of power lines by means of synchronous condensers at the ends and at intermediate points is discussed and compared with a proposed method in which neutralizing networks are neutralized at intervals. Each network consists of a pi whose series and shunt elements neutralize the corresponding elements of the line at the frequency of transmission. It is stated that the synchronous condensers increase the power transfer limits of the line but decrease the transmission efficiency, while the neutralizing networks increase both the power transfer limits and the efficiency. Illustrative numerical examples are given for a 220,000-volt line, 500 miles long. Some possibilities of a transcontinental power transmission line are discussed.

*Electrical Conduction in Textiles. Part II—Alternating Current Conduction*,<sup>10</sup> by E. J. Murphy. This paper shows the variation of the equivalent parallel capacity and conductance of cotton and silk with relative humidity and frequency (for a small range). It also shows the effect of changes in the amount of electrolytic material in the textile. The main results are: At high humidities the capacity is greatly reduced by a reduction in the amount of electrolytic material

<sup>9</sup> Journal of the Franklin Institute, Vol. 207, February, 1929, pp. 165-192.

<sup>10</sup> Journal of Physical Chemistry, Vol. 33, February, 1929, pp. 200-215.

in the textile. The a.c. and d.c. conductivities of cotton approach each other as the humidity is increased and become equal at humidities greater than 80–85 per cent (that is, dielectric loss is entirely due to direct current conductivity in this range). At humidities lower than this a large part of the dielectric loss is not due to d.c. conduction, but this part of the dielectric loss is also strongly affected by the amount of electrolytic material in the textile. These characteristics can be explained if the textile is regarded as an electrolytic cell in which the absorbed water and dissolved salts form the electrolyte and the solid constituents of the textile act as a container which determines the volume, geometric form and specific conductance of the electrolyte. The capacity at high humidities is regarded as due chiefly to the electrolytic polarization capacity of this electrolyte.

*Electrical Conduction in Textiles. Part III—Anomalous Properties,*<sup>11</sup> by E. J. Murphy. This paper deals with the increase of conductivity with increasing applied voltage (the Evershed effect), and with the residual electromotive forces and changes in resistance produced by the passage of current through the textile. The results point to the conclusion that the Evershed effect is due to two factors, a back-e.m.f. due to electrolytic polarization, and an increase, caused by the increase in voltage, in the amount to which the ions adsorbed by the interface between the aqueous solutions and the solid material of the textile contribute to the total conductivity. The characteristics of the residual e.m.f. change with humidity; at high humidities the e.m.f. is apparently caused by chemical changes in the aqueous solutions due to their electrolysis. It was found that the passage of a current through a textile causes its resistance to become non-uniformly distributed, the distribution depending on the nature of the

<sup>11</sup> Journal of Physical Chemistry, Vol. 33, April, 1929, pp. 509–532.

electrode material; this is interpreted as due to changes in the chemical composition of the solutions in different parts of the textile. The anomalous properties can be explained in terms of the electrolytic cell mechanism suggested in the preceding paper by attributing to the solid in which the aqueous conducting paths are contained the properties of adsorbing ions and of hindering the equalization of concentration differences in the solutions by diffusion. Thus, all of the properties of conduction in textiles observed in this investigation can be explained in terms of a single general mechanism which appears to be a probable consequence of the colloidal structure of the materials.

*Study of Weller Brittleness Test for Paper*,<sup>12</sup> by R. L. Peek, Jr. and J. M. Finch. On the assumption that paper possesses certain basic properties, an expression is theoretically obtained relating the results of the Weller brittleness test to these basic properties, the dimensions of the sample, and the conditions of testing. Experimental data are presented which show that the effect of the sample dimensions and the conditions of testing are substantially as indicated by the theoretical expression. The theory is then employed to interpret the results of the test and to indicate the best form in which these may be expressed. The general question of testing for flexibility and brittleness is considered in the light of this study.

*Diffusion of Water through Rubber*,<sup>13</sup> by Earle E. Schumacher and Lawrence Ferguson. This article gives data on the diffusion of water through thirteen rubbers of different compositions. The mathematical derivation of a simple formula for calculating the rate of diffusion has been given. The diffusion measurements have shown: (a) that the rate of diffusion of

<sup>12</sup> Paper Trade Journal, Vol. 88, February 7, 1929, pp. 56-62.

<sup>13</sup> Industrial and Engineering Chemistry, Vol. 21, February 1, 1929, pp. 158-162.



water through a rubber membrane is inversely proportional to the square of the thickness; (b) that the rate of diffusion decreases greatly with increase in hardness; (c) that the effect of saturating the rubber with water is to increase the rate of diffusion through it, due probably not only to an increase in the water vapor pressure within the rubber, but also to a decrease in hardness; (d) that there is no intimate relationship between rate of diffusion and minor variations in the composition of the rubber.

*Effect of Arsenic on Dispersion-hardenable Lead-antimony Alloys*,<sup>14</sup> by K. S. Seljesater. Arsenic has no solid solubility in lead and is known to form a continuous series of solid solutions with antimony. Therefore, immediately after annealing and quenching the antimony is in solid solution in the lead, and there is a certain amount of eutectic between the lead-antimony solid solution and arsenic. After quenching, the lead-antimony solid solution is supersaturated (the same as if arsenic were not present) and minute crystals of antimony separate. Since arsenic is soluble in antimony, some of the arsenic present will be concentrated in the surface layer of the minute antimony particles, which will then possess surface conditions different from those of pure antimony particles. The condition of the alloy at this stage is analogous to a suspension in a liquid which has been partly stabilized by a third constituent. Agglomeration and precipitation will occur, but at a much slower rate than if the third constituent were not present. Arsenic, therefore, is to be considered as a retardant for the agglomeration of minute antimony particles in the lead matrix. The length of the stabilization time decreases at elevated temperatures. The offered explanation is in agreement with the fact that the increase in hardness is practically independent of the percentage of arsenic within limits investigated.

<sup>14</sup> Mining and Metallurgy, Vol. 10, February, 1929, p. 94 (abstract).

The addition of a third constituent insoluble in the solvent and forming a continuous series of solid solutions with the solute, might be of advantage to other kinds of age-hardenable binary alloys.

*A Precision Regulator for Alternating Voltage,*<sup>15</sup> by H. M. Stoller and J. R. Power. In this paper a recently developed precision voltage regulator for use with alternating current is described. It will maintain its output voltage constant to within 0.03 per cent over an input voltage range of 10 per cent and a load range of from zero to full load.

This regulation is accomplished by means of a small transformer inserted in one of the lines which boosts or bucks the impressed voltage by the required amount. The transformer is controlled by a vacuum tube circuit acting through an inductance bridge.

*An Application of Electron Diffraction to the Study of Gas Adsorption,*<sup>16</sup> by L. H. Germer. Under appropriate experimental conditions, electron scattering by a single crystal of nickel can give rise to diffraction patterns of four quite distinct types. We attribute one of these patterns to the space lattice of the nickel crystal, one to the topmost layer of nickel atoms, one to a monatomic layer of adsorbed gas atoms, and one to a thick layer of gas atoms. From these phenomena some conclusions concerning gas adsorption have been drawn. We have at hand a new and important method of crystal analysis.

*Magnetic Alloys of Iron, Nickel, and Cobalt,*<sup>17</sup> by G. W. Elmen. Recent investigations of magnetic properties of alloys of iron, nickel and cobalt have resulted in the discovery of materials of remarkable magnetic properties previously unknown. In a brief review,

<sup>15</sup> Journal of the A. I. E. E., February, 1929, Vol. 48, pp. 110-113.

<sup>16</sup> Translated from "Zeitschrift für Physik," April 12, 1929, pp. 408-421. Bell System Technical, July, 1929.

<sup>17</sup> Journal of the Franklin Institute, Vol. 207, May, 1929, pp. 583-617. Bell System Technical Journal, July, 1929.

early experiments that led to the discovery of these materials and the magnetic properties of the entire field are discussed. Those groups of alloys of outstanding scientific and technical importance such as the permalloys and the perminalvars and special heat treatment required for development of special magnetic properties are taken up in detail. A theory is suggested to account for some of the magnetic characteristics, and a few of the practical applications of these materials are described.

*A Test for Polarization of Electron Waves by Reflection*,<sup>18</sup> by C. J. Davisson and L. H. Germer. A homogeneous beam of electrons is directed at 45° incidence against a (111)-face of a nickel crystal. The beam regularly reflected from this face impinges upon a second similar face at the same incidence angle. A Faraday collector is set to receive electrons regularly reflected from the second crystal, but only such electrons are accepted into the collector as have survived the two reflections without appreciable loss of kinetic energy. The collector and second crystal are rigidly joined, and may be rotated about the axis of the beam proceeding from the first to the second crystal. Measurements of the intensity of the twice reflected beam have been made at bombarding potentials from 10 to 160 volts. Within this range selective reflections (intensity maxima) are observed at 20, 55, 77, 103 and 120 volts.

These five selectively reflected beams have been separately tested for polarization by measuring the current received by the collector as a function of the azimuth of the movable system. If electron waves are polarized by reflection the intensity of the twice reflected beam should be greatest when the planes of incidence of the two reflections coincide, and least when they stand normal to one another. No such variation of the current to the collector is observed within the limits of error

<sup>18</sup> Phys. Rev., Vol. 33, May, 1929, pp. 760-772. Bell System Technical Journal, July, 1929.

of the measurements—about one-half of one per cent of the total current. *Our observation is that electron waves are not polarized by reflection.*

*A Generalization of Heaviside's Expansion Theorem,*<sup>19</sup> by W. O. Pennell. The expansion theorem is one of the most frequently used methods of evaluating operational forms arising from the operational calculus, developed by Heaviside. The original theorem, however, is applicable, in general, only to expressions containing integral powers of the operator  $d/dt$ . This paper describes an extension to, or a generalization of the original expansion theorem whereby, in general, operational forms with either fractional or integral powers of the operator can be evaluated. A number of operational equivalents are given to be used with the theorem, one of which is the equivalent used by Heaviside. Examples of the application of the theorem to electric circuit problems are shown.

*A High Precision Standard of Frequency,*<sup>20</sup> by W. A. Marrison. A new standard of frequency is described in which three 100,000-cycle quartz crystal-controlled oscillators of very high constancy are employed. These are interchecked automatically and continuously with a precision of about one part in one hundred million. They are checked daily in terms of radio time signals by the usual method employing a clock controlled by current maintained at a submultiple of the crystal frequency. Specially shaped crystals are used which have been adjusted to have temperature coefficients less than 0.0001 per cent per degree C.

*Observations on Modes of Vibration and Temperature Coefficients of Quartz Crystal Plates,*<sup>21</sup> by F. R. Lack. The characteristics of piezo-electric quartz

<sup>19</sup> Bell System Technical Journal, July, 1929.

<sup>20</sup> Bell System Technical Journal, July, 1929; presented before Institute of Radio Engineers, April 3, 1929.

<sup>21</sup> Bell System Technical Journal, July, 1929; presented April 3, 1929, before Institute of Radio Engineers.



crystal plates of the perpendicular or Curie cut are compared with parallel or 30-degree cut plates with reference to the type of vibration of the most active modes, the frequency of these modes as a function of the dimensions, and the magnitude and sign of the temperature coefficients of these frequencies.

It is pointed out that the two principal modes of the perpendicular cut plate appear to be of the longitudinal type, the high-frequency mode being a function of the thickness while the low-frequency mode is a function of the width (along the electric axis). Both modes have a negative temperature coefficient of frequency. Of the two corresponding modes of the parallel cut plates a shear vibration is responsible for the high frequency. This frequency has a positive temperature coefficient. The low-frequency mode is of the longitudinal type and has a negative temperature coefficient.

Considering only the high-frequency vibration of these plates it is observed that there are characteristic variations of the frequency and temperature coefficient with the ratio of dimensions of the plate and the temperature, which are peculiar to the parallel cut plate. These variations can be attributed to a coupling of the shear and longitudinal modes.

It is then shown that if the parallel cut plate be treated as a group of coupled oscillatory systems with appropriate temperature coefficients the usual coupled system analysis will explain the curves of frequency *vs.* dimensional ratio, frequency *vs.* temperature, and temperature coefficient *vs.* dimensional ratio that are characteristic of this plate. This analysis offers an explanation of the low temperature coefficients which can be produced by a proper choice of the dimensional ratios.

*Master Reference System for Telephone Transmission*,<sup>22</sup> by W. H. Martin and C. H. G. Gray. The tele-

<sup>22</sup> Bell System Technical Journal, July, 1929; presented before A. I. E. E. Summer Convention, June 24-28, 1929.

phone transmission system described here is the Master Reference System of the Bell System for the expression of transmission standards and the ratings of the transmission performance of telephone circuits. The transmitter and receiver elements of this system are reference standards for the ratings of the transmitting and receiving performance of terminal station sets.

A replica of this reference system, installed in Paris, has been adopted as the Master Reference System of the International Advisory Committee on Long Distance Telephone Communication in Europe. The establishment of these two master systems provides a common reference for the telephone transmission work of the Bell System and the telephone administrations which are members of this International Advisory Committee.

*Shielding in High-Frequency Measurements*,<sup>23</sup> by John G. Ferguson. The purpose and usefulness of shielding in high-frequency measurements are outlined. General principles of electrostatic shielding are developed as applied to simple impedances and to networks of impedances, particularly to bridge networks. Practical applications of these principles to the shielding of adjustable impedances, and in the construction of actual bridge circuits are described.

*Fatigue Studies of Non-Ferrous Sheet Metals*; <sup>24</sup> by John R. Townsend and Charles H. Greenall. The paper describes the development of a fatigue test machine for sheet metals and gives results of fatigue tests on five alloys of alpha brass, one alloy of nickel silver, one alloy of phosphor bronze and Everdur.

The results indicate that cold work raises the en-

<sup>23</sup> Bell System Technical Journal, July, 1929; presented before the A. I. E. E. Summer Convention, June 24-28, 1929.

<sup>24</sup> Bell System Technical Journal, July, 1929; presented before American Society of Testing Materials Convention, June 24-28, 1929.

durance limit but not proportionally to the increase in tensile strength produced by the same cause.

Micrographs are shown indicating that fatigue failure of the metals investigated is transcrystalline.

Dispersion hardening of alpha brass by nickel silicide increases the endurance limit.

The ratio of endurance limit to ultimate tensile strength of these alloys varies from .12 to .36 depending on composition, heat treatment, and cold work. These ratios are much lower than similar ratios for steel.

## Notes on Recent Occurrences

### A. T. AND T. CO. BONDS OFFERED TO STOCKHOLDERS

**A**T a special meeting of the stockholders of the American Telephone and Telegraph Company held on April 30, the directors were given power to authorize the issue of not exceeding \$225,000,000 of convertible bonds, the stockholders to be offered the right to subscribe for the bonds at their face value in the proportion of \$100 of bonds for each six shares of stock held.

Following the meeting of the stockholders, the directors authorized the issue of Ten-Year Convertible 4½% Gold Debenture Bonds of the Company to be dated July 1, 1929, and the stockholders of record at the close of business on May 10, 1929 were mailed subscription rights. The amount thus offered is approximately \$219,000,000.

The purpose of the issue is to provide funds for the payment of approximately \$75,000,000 of the Collateral Trust Four Per Cent. Bonds of the Company due July 1, 1929 and for new construction which is required by the Bell System to care for additional business resulting from the continuously increasing use of telephone service.

The bonds are convertible into the stock of the Company on January 1, 1930 or at any time thereafter, but not later than December 31, 1937, but if called for redemption on any date within that period they may be converted not later than their redemption date.

The conversion price is, during the year 1930—\$180 per share; during the years 1931 and 1932—\$190 per share; and during the years 1933 to 1937, inclusive,—\$200 per share. These prices are subject to reduction upon the issue from time to time of additional stock



by the Company, all as stated in the Indenture under which the bonds are issued.

In their conversion the bondholder may take one share of stock for each \$100 of bonds surrendered, on paying in cash for each share, the difference between the conversion price then in effect and \$100; or, the bondholder may take as many shares of stock as the principal amount of bonds surrendered will pay for at the conversion price then in effect, and if there is a remainder, the bondholder may take one additional share on paying in cash the difference between the current conversion price of a share and such remainder.

At the time bonds are surrendered for conversion an adjustment in cash must be made of accrued interest and dividends.

The bonds will be redeemable upon sixty days' published notice. If prior to January 1, 1938, the redemption price is 105, and if on or after January 1, 1938, the redemption price is 100. Redemption of less than all of the bonds must be on an interest-payment date.

The issue has not been underwritten.

#### H. P. CHARLESWORTH MADE CHAIRMAN OF N. Y. SECTION, A. I. E. E.

AT the Annual Meeting of the New York Section of the American Institute of Electrical Engineers, April 26, announcement was made of the election of H. P. Charlesworth, Vice President of the Bell Telephone Laboratories, as Section Chairman for the coming year. The New York Section, with a membership of about four thousand in the metropolitan district, is the largest of the A. I. E. E. sections.

## TWO-WAY TALK BETWEEN TELEPHONE AND FLYING AIRPLANE DEMON- STRATED BY BELL SYSTEM

A DEMONSTRATION of two-way telephone communication between an airplane in flight and telephones connected to the ordinary land lines of the Bell System took place on May 1. Reporters of the metropolitan press, flying in the Bell Telephone Laboratories' airplane over northern New Jersey, conversed with the men at the city desks of their respective newspapers in New York. The conversations were easily understood and the experiment was highly successful in spite of rather unfavorable weather conditions.

Each reporter in turn, seated in the "flying telephone booth" in the Wasp-motored Fairchild cabin monoplane, was equipped with headphones and spoke into a hand microphone with soft rubber sides to be pressed against his face, thus shutting out the noise of the airplane. The calls were transmitted via the Bell Telephone Laboratories' experimental radio station at Whippany, N. J., where connection was made with the ordinary telephone lines to the destination of the call. The radio telephone set used in the demonstration is extremely compact, weighing only about one hundred pounds.

## GENERAL PUBLICITY CONFERENCE

A GENERAL Publicity Conference, attended by publicity representatives of the Bell System, was held at Pinehurst, N. C., from April 10 to 17. Vice President Arthur W. Page, of the American Telephone and Telegraph Company, who presided at the conference, opened the sessions with a discussion of "The Problem of Forecasting Public Opinion in the United States."

The following papers were presented: "The Merger

Movement," S. L. Andrew, Chief Statistician, A. T. & T. Company; "The Future of the Bell System" (with special reference to prospective service improvements), Bancroft Gherardi, Vice President, A. T. & T. Company; "Results of Effort to Develop Understanding of Bell System Policy and What Should Be Done to Perpetuate This Understanding," W. B. Clarkson, Assistant to President, Chesapeake & Potomac Telephone Company; "The Opportunity that Publicity Has to Develop a Sales Consciousness and to Promote Sales," F. J. Reagan, Vice President, Pacific Telephone & Telegraph Company; "Publicity Functions and Type of Organization Required to Perform Them," H. C. Young, Vice President, Bell Telephone Company of Pennsylvania; "The Selection and Development of Personnel for Publicity Work," L. C. Witcher, General Publicity Manager, New York Telephone Company; "How Can Publicity Assist in Meeting our Responsibility to the Rural Telephone User?" F. C. Builta, Assistant to President, Northwestern Bell Telephone Company; "Tangible and Intangible Results of Publicity; What Can Be Measured and How," P. L. Schauble, General Information Manager, Bell Telephone Company of Pennsylvania; "Need for Signs on Buildings, Public Telephones and Roads in Metropolitan and Rural Areas and Value of Standardized Signs," T. J. Feeney, Assistant to President, New England Telephone & Telegraph Company; "Foreign Language Newspaper Advertising; Its Value and Place in an Advertising Program," A. F. Hardman, Assistant to Vice President, Ohio Bell Telephone Company; "The Relationship between Business and the Press," Evelyn Harris, General Publicity Manager, Southern Bell Telephone & Telegraph Company; "Sound Pictures—A New Publicity Medium," H. G. Stokes, Motion Picture Director, A. T. & T. Company. Mr. Stokes' talk was illustrated by means of the new portable sound projector developed by the Bell Telephone Laboratories

and the Western Electric Company, Inc. for Electrical Research Products, Inc.

The conference was also addressed informally by President W. S. Gifford and Vice President N. T. Guernsey, of the American Telephone and Telegraph Company.

On the last day of the conference, B. V. Flannery of N. W. Ayer and Son, advertising agency of Philadelphia, spoke on "Effective Newspaper Layout" and P. Lewis, also of N. W. Ayer and Son, on "Copy." After the sessions at Pinehurst several members of the conference were the guests of N. W. Ayer and Son for a day in Philadelphia.

### 1929 OPERATING CONFERENCE

THE seventh Operating Conference, held at White Sulphur Springs, West Virginia, from May 1st to 8th, was attended by the Operating Vice Presidents and General Managers of the Associated Companies and representatives of the staff of the American Telephone and Telegraph Company.

At the start of the conference Mr. Gherardi presented a very comprehensive review of the operating results and trends of the business. This review included consideration of the financial, engineering, plant, traffic and commercial performance for 1928, the background for the estimates and forecasts for the five-year period, and the material and equipment supply situation. Mr. Gherardi also discussed the matter of efficiency in operation, the opportunities for new services, some organization and personnel matters and the developing and maintaining of a proper attitude of mind toward the business and toward customers. This survey showed clearly that steady progress is being made toward an efficient service and a service more pleasing to the public and that the outlook for the future is definitely in the direction of continued improvement.



A large part of the discussions of the conference was based on the reports of a number of special committees which were selected early in the year to report on matters of particular moment at this time. The subjects of these committee reports are given below as they are of general interest as indicating the lines along which special emphasis is being placed:

- Sales Program and Organization
- Promoting Toll Use
- Party Lines and Their Effect on Service
- Service Outside the Base Rate Area and Rural Service
- Private Branch Exchange Service and Operation
- How Can Management Discover and Remove Causes for Complaints and the Failure to Satisfy Customers' Requests?
- Installation of Service—Appointment Plan
- Collection Methods and Denial of Service
- Commercial Department Service and Business Office Operation
- Supervisors' Training—Development of the Administrative Personnel

The conference was addressed by Mr. Cooper, Mr. Page, Dr. Jewett and Mr. Bloom. Mr. Charlesworth outlined the work being done by the Bell Telephone Laboratories, and in connection with his talk, arranged an interesting demonstration of wireless telephone communication with airplanes.

## 1929 ENGINEERING CONFERENCE

The Engineering Conference held at Shawnee-on-Delaware, Pennsylvania, from June 5th to 12th, was attended by the Chief Engineers, representatives of the general staffs of certain Associated Companies, representatives from the Northern Electric Company, the Western Electric Company, the Bell Telephone Laboratories and the general departments of the A. T. & T. Company, the total attendance being about 130. Although each of the previous five meetings of the Chief Engineers had been held jointly with the other operating departments, the increase in the number of operating areas made a separate conference necessary.

At the beginning of the conference Mr. Gherardi presented a comprehensive review of the operating results and trends of the business which gave the conference members a very clear picture of the financial, engineering, plant, traffic and commercial results for 1928, together with the background of estimates, forecasts and trends for the five-year period.

The first general subject, that of Provisional Estimates and the Material Supply Situation, was covered by a group of papers dealing with Provisional Estimates and Estimating, Western Electric Expansion Program, and the Material Supply Situation, also a report of a committee of Chief Engineers discussing the Forecasting of Material Requirements.

A large part of the program was devoted to additional reports of committees of Chief Engineers organized prior to the conference to study some of the problems which are of particular interest to the Chief Engineers at this time. These reports were generally followed by open discussions in which members of the conference generally participated. The subjects of the reports which indicate those phases of the engineering work which are of particular importance at this time are as follows:

- Toll Facilities and Associated Problems
- Plant Extension Engineering
- Appearance of Plant
- Building Activities
- Rural Service and Small Exchange Problems
- Station and Related Activities
- Transmission Activities
- Foreign Wire Relations

Papers also were presented dealing with Communication Services for Power Companies and Depreciation Activities.

Talks of especial interest were given by Mr. Page, Mr. Waterson, Mr. Colpitts, Mr. Charlesworth, Mr. Wilson and Mr. Harrison, Chairman of the Conference.

Throughout the conference, the coordination of sales efforts, the construction program including the material supply situation, and financial results so as to obtain a balanced result, was stressed as being the most important problem before Chief Engineers in the next two or three years. From a technical standpoint, organizing, planning and engineering for the large toll program which is ahead was of major importance.

Some of the more recent developments in equipment, labor saving machinery, material, methods and practices were exhibited. There was also an interesting display of building photographs illustrating the great improvement in the appearance of the newer buildings in the Bell System.

At an evening session an interesting demonstration was given by Mr. Jones of the latest development in sound pictures. Moving pictures also were shown by Messrs. Hull and Mier of the construction methods employed in Texas and Oklahoma in connection with new types of buried cables.

#### NEW SHORT-WAVE TELEPHONE TRANSMITTING CENTER OPENS AT LAWRENCEVILLE, N. J.

ON June 1 the American Telephone and Telegraph Company's new short-wave radio telephone transmitting center at Lawrenceville, N. J., began commercial operation.

By the end of the year it is expected that the transmitters of two additional short-wave channels to Europe, and one to Buenos Aires, Argentina, will be operating from this point. The present short-wave transmitter at Deal, N. J., will then be taken out of commercial operation, to be used thereafter for experimental purposes.

Providing a third transatlantic speech channel, the new short-wave unit supplements the long-wave and short-wave systems previously operating between the

United States and Europe, which were becoming congested with traffic.

As the result of months of experiment and testing by engineers of the A. T. and T. Company and the Bell Telephone Laboratories, Inc., the sending equipment at Lawrenceville presents a number of improvements over that in the older short-wave system. The transmitting antennae for Europe are strung on a line of nineteen 180 foot steel towers, placed 250 feet apart and at right angles to the direction the voice waves travel. Each of the three transatlantic channels has three horizontal aerials, paralleling each other perpendicularly, connected by cross wires; they resemble a huge wire net of irregular mesh.

Behind the transmitting antenna is a second, similar arrangement, designed to reflect the voice waves from the transmitting antenna, and to reinforce them. As the equipment is directional, the energy is thus focussed toward the point it is to reach. At the same time, each antenna can transmit on three different wave lengths, so that when all the channels are completed they will be able to operate simultaneously without interfering with each other.

#### ACADEMIC HONORS FOR A. T. AND T. CO. OFFICIALS

On June 10th, President Walter S. Gifford received from Colgate University the honorary degree of Doctor of Laws. Oberlin College conferred upon Mr. Gifford the honorary degree of Doctor of Science on June 18th.

Vice President F. B. Jewett received the honorary degree of Doctor of Science from the University of Chicago on June 11th.

On June 18th, H. B. Thayer, former President, received from Dartmouth College the honorary degree of Doctor of Laws.







New Short Wave Transmitting Center Near Lawrenceville, N. J. for European and South American Telephone Service  
(Airplane photograph retouched to emphasize arrangement of antenna system)

# BELL TELEPHONE QUARTERLY

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AND A RECORD OF PROGRESS

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## Short Waves and Long Waves in Transatlantic Radio Telephony

THE various points on the two sides of the Atlantic which can now be interconnected by the transatlantic radio telephone system have been added so gradually that the magnitude to which the total network has grown may not be generally appreciated. On January 1, 1929, there were over seven million telephones in Europe and nearly twenty-one million in North America to which transatlantic service was available. The total, twenty-eight million, represents 85 per cent of the telephones in the world. It is inevitable that with such a field to draw from the traffic across the Atlantic should grow vigorously and the need for further telephone links to care for this traffic soon become acute. A telephone cable to provide a circuit of maximum reliability is now being engineered and other radio links are being considered. The type of radio facilities best adapted to meet this need is a problem requiring careful engineering consideration along several lines.

A transatlantic radiotelephone circuit is made up of two one-way radio paths or channels for speech trans-

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mission, one transmitting from New York to London and the other transmitting from London to New York. Taken together, these two oppositely directed, one-way channels form a "radio circuit" for two-way speech transmission. At each terminal the incoming and the outgoing radio paths must form a junction with the wire terminal system so as to operate properly with the two-way speech path represented by the single pair of wires extending to the subscriber's telephone instrument. This is done through the agency of an automatic switching device which, in response to the voice current coming from the subscriber's instrument, connects either the incoming or the outgoing radio path to the wire terminal circuit, in accordance with the flow of conversation back and forth, between the two talkers. This junction apparatus or system is the same no matter what type of radio facility is employed in setting up the pairs of channels which link the two junction points. Thus, the choice of radio facilities has been to a large extent divorced from matters of interconnecting these facilities with wire lines.

There are two classes of radio waves capable of traveling long distances and, therefore, suitable for setting up transoceanic radio links. These are: long waves, which may be assumed to include radio frequencies from about 40 kc. to 100 kc. and short waves, which may be assumed to include radio frequencies from about 5,000 kc. to 20,000 kc. The radio frequencies or wave lengths lying between these two classes of waves are suitable for shorter distance transmission and are used for ship-to-shore telegraphy, broadcasting and similar services. The first transatlantic circuit, opened in 1927, was a long-wave circuit. The traffic on it grew to the point where another circuit was needed and, in June, 1928, a short-wave circuit was opened for service. Experience with these two circuits, representing the two wave classes available for the purpose, furnishes a basis for comparative discussion. The first



question which might naturally arise is, which one of these two types of circuit is better adapted to transatlantic radiotelephone service? The answer is, both. The two types have different characteristics. They tend to supplement each other rather than to compete with each other.

There is less difference in the simple transmission efficiency of long and short waves than one might be led to expect by the newspaper reports of long distances often spanned by amateurs using low power short-wave transmitters. A given amount of power radiated toward a distant receiving station under normal conditions produces approximately the same order of received signal strength whether the wave be long or short. There are, however, great differences in the variations in transmission efficiency to which the two classes of waves are subject. Long waves undergo a diurnal variation, signals being stronger at night and weaker by day, but, provided there is reasonably sufficient transmitting power, some signal is always received except for a brief interval at sunset. The workability of the radio link is governed by the amount of noise present to mask or obscure the signal; the way in which this noise varies and the effectiveness of the means used to suppress it govern the results obtained.

A short wave of a given wave length or frequency has good transmission efficiency during only a portion of the day. At other times of the day the efficiency may be so low that substantially no signal can be received. Fortunately, different short-wave lengths have their best transmission at different times of day and it is possible to choose three wave lengths, at least one of which will, under average conditions, be good at any given time. Radio noise is a factor, but one of a lesser order than is the case with long waves. There are two other types of variation which also affect short waves but which are substantially absent with long waves. These are: fading, or relatively rapid,

moment to moment variations in the strength of received signals, and "wash out" periods, when, for one or more days transmission may be very poor and signals extremely weak. Wash out periods usually are associated with magnetic storms. During magnetic storms the transmission efficiency of short waves is frequently reduced to the point where communication is impossible until the storm has passed. These three kinds of variations to which short waves are subject are a drawback to their effective use and constitute the transmission problem against which research is now being directed.

One of the prime requirements for telephone service is reliability. Neither the long wave nor the short wave transatlantic circuits give usable results 100 per cent. of the time. With the present apparatus, the long wave circuit is somewhat more reliable than the short wave, but both will be improved as improvements in the apparatus are made and experience is obtained with their operation. Aside from the "sunset dip" poor transmission times on long waves are in general due to excessive noise or static. Poor times on short waves are more often due to weak signals, fading, or magnetic storms. Since the causes in the two cases are different, the likelihood of simultaneous incidence of bad periods on the two wave classes is reduced. This is particularly true, for instance, of the interruptions accompanying magnetic storms, which wipe out short-wave transmission but actually improve long-wave transmission. Thus the combination of a short-wave circuit and a long-wave circuit gives a greater assurance of continuous service than can either type of circuit alone. Whether either type can be brought to a point of reliability sufficient to enable it to furnish continuous service by itself remains for the future to disclose.

Lying, as they do, at opposite ends of the radio frequency spectrum it is not strange that long waves and

short waves employ rather different types of plant. For receiving, both use directive antenna systems to increase signal and decrease noise but these systems are of quite different construction. Long-wave receiving apparatus is similar in many ways to wire carrier telephone equipment. Short-wave receiving apparatus even at its present stage of development involves special devices to combat radio transmission variations and further developments will undoubtedly bring forth many auxiliary devices for this purpose.

For transmitting, long waves require a large and costly antenna to radiate effectively. With present types of antenna, since the radiation goes out in all directions, and only a small part of it travels toward the receiving station, a very powerful transmitter is necessary to produce a sufficient received signal. For short waves, an individual antenna is relatively much smaller and it is possible to combine antennas into arrays which direct the radiation into a small geographical sector. The radiated power is thus used much more effectively and a smaller transmitter will suffice. However, three separate antenna structures must be built to handle the three different wave lengths.

The difference just pointed out between the relatively enormous size of a long-wave antenna and the diminutive size of a single short-wave antenna discloses one reason why experimenters are able to obtain much better long-distance transmission with short than with long waves. A few dollars will buy a short-wave antenna which will compare favorably in simple radiation efficiency with a long-wave antenna costing many thousands of dollars. Thus, an efficient long-wave antenna is denied the average experimenter and we do not hear of long-distance records of transmission being made by experimenters with low-power long-wave sets. When reliable commercial results are required, the expansion of the short-wave antenna into an array and the provision of a number of these arrays to cover the

several wave lengths to be used make the comparison an entirely different sort of thing.

Long-wave systems are more expensive to build and operate than short-wave systems. But considerations of continuity of service must weigh heavily in modifying cost comparisons. Both types of system appear necessary to a well-rounded service.

The preceding remarks apply to transatlantic radio telephone links between United States and England. This route is particularly favorable to the use of long waves since the distance is moderate and the path largely over water, and since the main sources of static are in directions which permit realization of large improvements from directive antennas. For such a route as from United States to South America, where the distance is greater, and where the receiving antennas must look directly toward equatorial regions which are major sources of static, long waves can be of little value and short waves must be relied upon.

RALPH BOWN.



# The Straight-Line Depreciation Accounting Practice of Telephone Companies in the United States

*(Paper presented to International Congress on Accounting, New York, September 9-14, 1929.)*

**W**HEN the telephone business originated, a little over fifty years ago, electrical science was in its infancy.

There was no accumulated knowledge or experience to which the telephone engineer could have recourse; indeed there was no such person as an electrical engineer as we use the term today. There was no college which taught electrical engineering. There were no electric power lines, no trolley cars.

The telephone was not an improvement upon something previously existing—it was wholly new and strange. When the instruments were made commercially available, the whole science and art of telephony was still to be created. There was no switchboard, no signalling apparatus, no knowledge regarding the telephone line circuit or indeed of any of the facts that have since been found needed to make the telephone a reliably useful thing.

Everything had to be worked out and energetic research and development work brought a continuous flow of inventions. Equipment which had been the best yesterday was today dethroned by something later and better.

In addition to rapid advances in the art affecting all parts of the investment, telephone plants in the open were partially destroyed by storms or other casualties. The great enemy of the outdoor plant proved to be the sleet storm.

The early telephone wire lines in cities, which were almost exclusively aerial, soon became unsightly and

inconvenient and as the size of the plants increased public convenience and necessity were served by the progressive substitution of aerial cables for open wires and later by the introduction of underground conduits and cables which removed many of the lines from sight altogether.

#### EARLY RECOGNITION OF DEPRECIATION BY TELEPHONE MEN

Telephone men were thus early brought to a realization that the maintenance cost of providing telephone service included something more than the day-to-day upkeep of the property; it included the cost occasioned by the using up of major portions of the property.

The first circular recommending a system of telephone accounts was sent out by the American Bell Company to its various local licensee companies throughout the country in 1884. Written at a time when depreciation accounting had generally received but scant attention in the business and industrial concerns of America, this circular clearly recognized depreciation as a cost of operation. It said, in part:

. . . It is certain that the present expense for Repairs and Reconstruction is not proportionate to the actual deterioration of property and that in future years the revenue of most companies will be subjected to much heavier charges on this account. It is suggested that a reserve fund be set apart, to which shall be carried such part of the annual profits as represents the estimated amount of yearly depreciation not covered by the expenditure on account of Repairs and Reconstruction.

A depreciation rate of 10% was suggested in this circular as a reasonable composite rate for all classes of telephone property taken together.

Neglect of depreciation was one of the historical causes of financial disaster to many of the smaller telephone companies in the United States and the ability of the companies of the Bell System and various of the independent companies to maintain themselves is un-

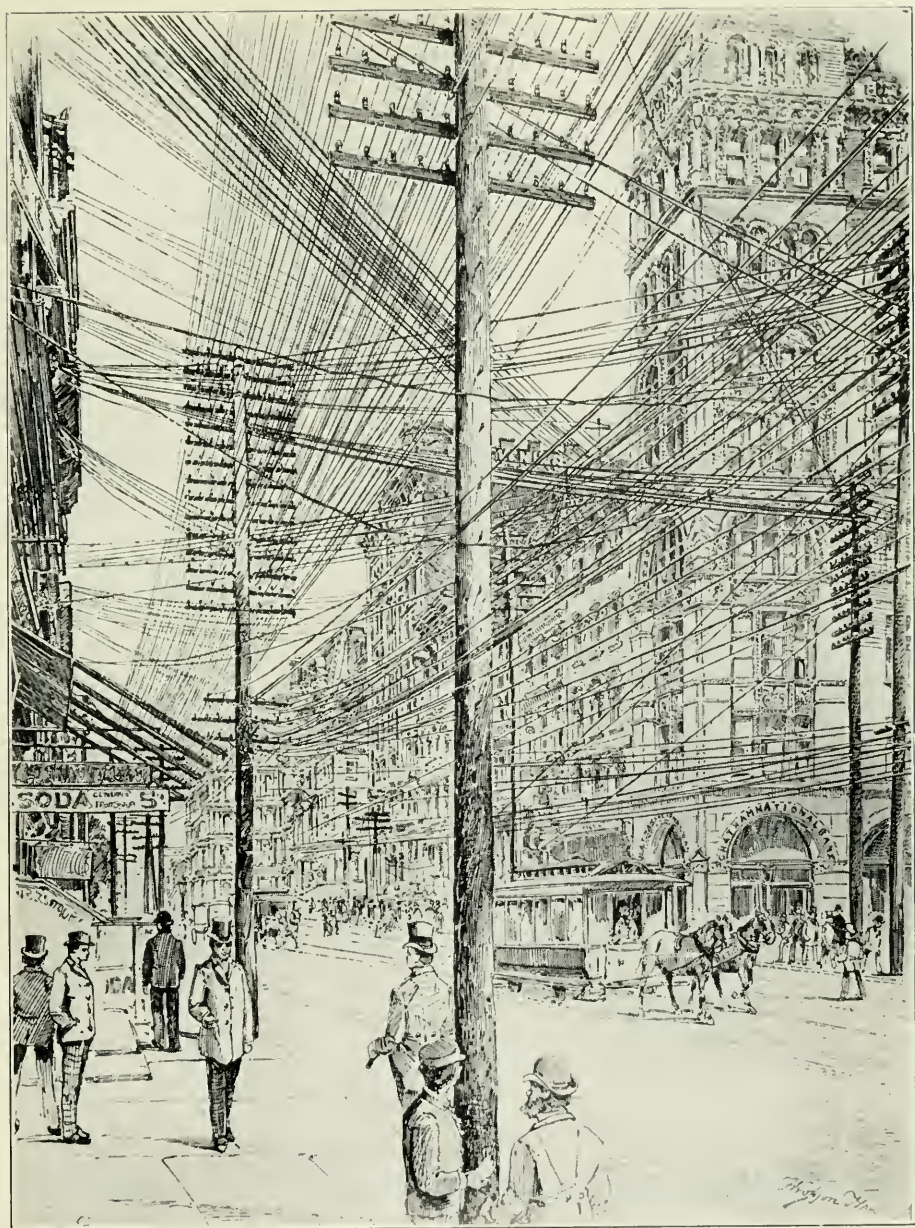


FIG. 1. Broadway and John Street, New York City, 1890



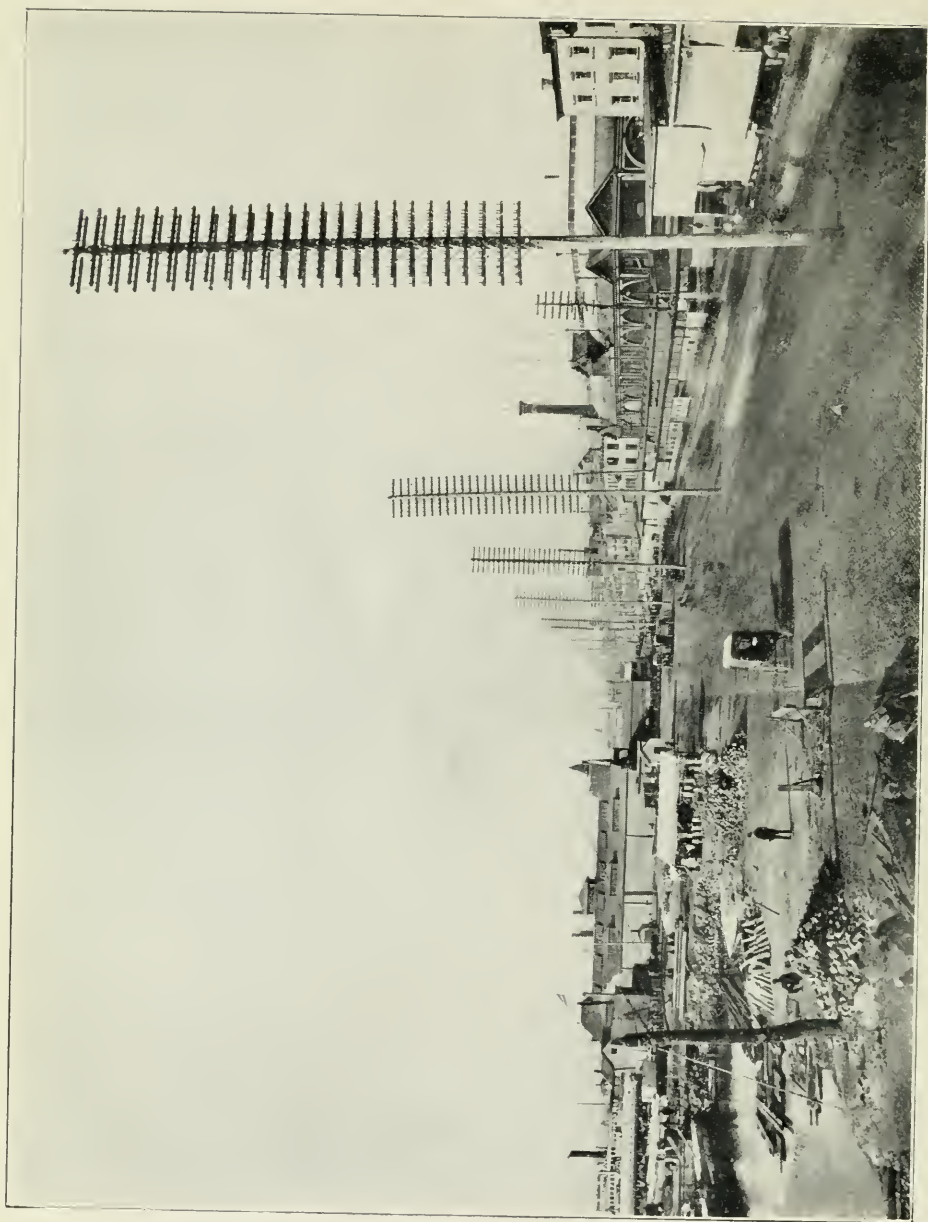


Fig. 2. West Street Pole Line, New York City, Erected in 1887, 90 Foot Poles, 25 Cross-Arms, 250 Wires



doubtedly traceable in part to a better perception of the nature of depreciation in the operating property.

#### PRESENT ACCOUNTING

About the years 1908 to 1910 the Bell Companies generally were making provision for depreciation by charging operating expenses with the difference between (a) the amount of depreciation expense computed by the application to the property in use during the year of the current depreciation rates and (b) the amount of depreciation overcome by that year's reconstruction. Since that time, the general practice has been to charge operating expense and credit depreciation reserve with the full amount of the accruing depreciation for the year and to charge against the accumulated reserve the losses on property retired; all depreciation transactions being thus mirrored by the reserve.

In 1912, the Interstate Commerce Commission promulgated a Uniform System of Accounts, mandatory for use after December 31st of that year by all of the larger telephone companies throughout the United States. The mandatory system (still in effect) required the use of depreciation reserve accounting and assigned depreciation to the operating expenses as a branch of Maintenance; the annual depreciation charges against earnings to be in such amounts as should distribute, as nearly as may be, evenly throughout the service life of the property, the cost of property consumed in operations. This is accomplished by the "Straight-Line" method.

The formal recognition of depreciation as an operating expense by the government authorities was very satisfactory to the telephone accountants at the time, for in view of the characteristics of the telephone business, they regarded—as indeed they still do—a sound method of depreciation accounting as imperative for it.

The universal agreement on this point among both

Bell and independent telephone companies and the government experts is significant.

#### CHARACTERISTICS OF DEPRECIABLE TELEPHONE PROPERTY

Some of the characteristics of the telephone business of importance in this relation are:

##### *Growth*

The business has increased in a half century amazingly. Beginning with a few hundred thousand dollars

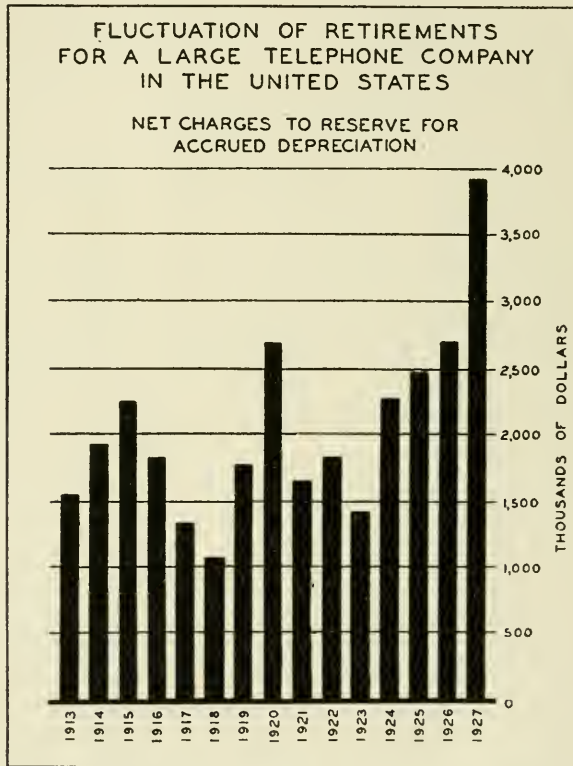


FIG. 4

in 1878, the Bell Companies had in 1917 plants which had a first cost of over one billion dollars. From 1917 to 1923 another billion dollars was added, as net prop-

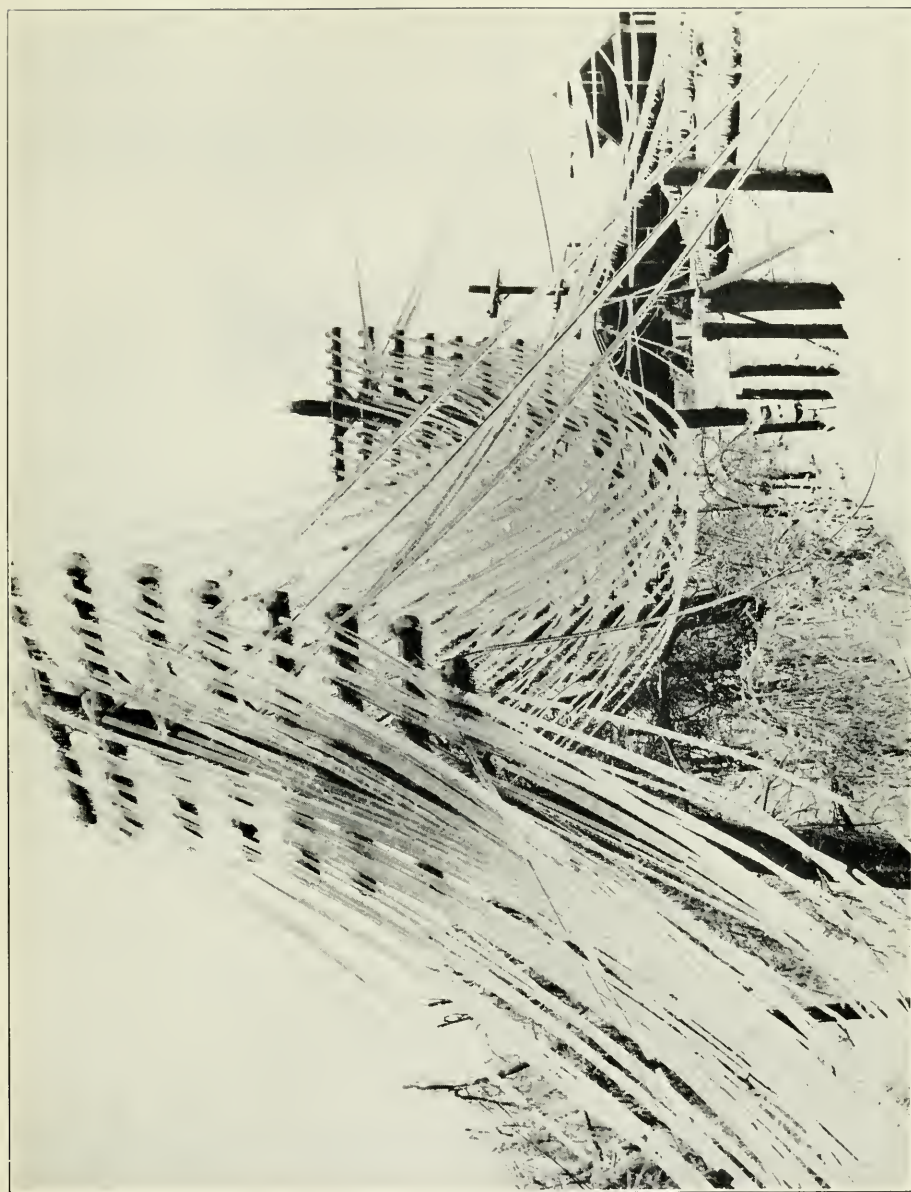


FIG. 3. Result of Sleet Storm





erty additions. At present these companies have more than three and a quarter billions of dollars of telephone property and the four billion mark will be passed shortly after the close of this decade. The telephone companies not comprised in the Bell System also have very considerable growing property investments.

### *Short Service Life*

Due to wear and tear, changes in the art, storms and casualties, public requirements and above all to inadequacy due to growth of the service, most telephone plant has a relatively short service life; the average composite life of the plant as a whole, excluding underground conduit, being less than fifteen years.

### *Fluctuation in Retirements*

Retirements are by no means uniform from year to year. They fluctuate over a wide range, not merely for the individual classes of plant, but for all of the classes taken together. The annual fluctuations are so serious that if the net retirement charges for the year were taken into the operating expenses in lieu of the proper depreciation accrual, these expenses—in addition to seriously understating the true expense of depreciation—would be highly irregular.

### *Location of Property*

A large percentage of telephone property is placed upon premises not under the control of the telephone company, such as public buildings, highways and alleys and the premises of its individual subscribers. This property is subject to the changing conditions affecting such public or private property, as well as to ordinary depreciation hazards.

With these special characteristics of the telephone business in view, the suitability of the straight-line method will be apparent probably to most accountants. But not everyone is an accountant and it has frequently

been necessary to explain and to defend the fundamental soundness of the depreciation rules of telephone companies.

THE THEORY OF "STRAIGHT-LINE" TELEPHONE  
DEPRECIATION

The Bell System's position in respect of straight-line depreciation accounting admits of very simple statement.

The operating expenses to be entire must reflect the cost of all of the things purchased and used up in conducting the operations. This includes the cost of some things which are used up at once or in a short time, such as operating labor, lunch room supplies, coal or stationery; and of other things which are used up slowly, such as tools, furniture, automobiles, poles and switchboards. The ultimate cost of a service must include the cost of everything used up in furnishing it, and if a telephone company in the rendition of its telephone service uses up any property, then the cost of that property is necessarily a part of the cost of that service.

The function of the accounts is to record the facts as to the transactions of the company. Any item of operating cost is an operating expense. If any item of such cost is omitted from the operating expenses they will not reflect the facts. Granting that the cost of property used up is operating expense, the next question which presents itself is as to the time when the expense should be charged in the accounts. It is a fundamental rule of accounting that charges for expense should be made to the accounts of the period to which the expense relates and for the benefit of which it has been incurred. The expense of depreciation is incurred within the period when the property is being employed to render the service. It should therefore be charged to operating expenses within that period.

In the case of depreciable property of long life, the books must be opened and closed many times during the

life term and so the further problem arises as to how the accounts of each period can be made to provide equitably for the cost of the property which is being consumed. The straight-line method meets this problem simply, effectively and equitably. The company charges off against its revenues the actual net capital loss and only that loss, as nearly as it may be determined, and it charges to the operating expenses of any period only that proportion of the loss which is measured by the length of that period as related to the length of the entire useful life of the property lost. This practice is equitable because it reflects expense in the operating costs of successive accounting periods, only for such depreciable property as is in use for the benefit of these periods, and in an amount which is uniform and fair for each period, taken either separately or in combination with others.

There is nothing anomalous in the way this item of expense is treated under such a plan. It is the general practice to accrue within a term any expense incurred for that term regardless of when the cost is paid, whether in advance or in arrears. Taxes are accrued during the period to which the tax relates. Insurance premiums are apportioned to accounts over the life term of the policy. The same rule is followed with bond discounts and many other items. However, we should not insist that time is the sole unit of measurement applicable to the straight-line method. It has proven, so far, a quite suitable unit for employment in the telephone business, where the production and use of the service are continuous and variation in the extent of operating use causes as a rule but slight variation in the rate of wear and tear of the equipment. It is easy to conceive of cases in which the extent of use of depreciable property oscillates, or even fluctuates, widely in successive periods, and there are many industries where wear and tear is a major factor in depreciation closely associated with a varying extent of use.

The straight-line method is sufficiently versatile to

permit the employment of time in active operation, volume of output and similar units of measurement.

It is, of course, evident from what has just been said that the Bell System depreciation reserve is a retirement reserve, not a replacement reserve. Under the theory as stated, the amount of replacements cannot affect the amount of this depreciation expense. It is what the company loses in the way of original capital consumed which determines the amount of the loss, which would be exactly the same regardless of whether or not replacements are made. Telephone companies moreover seldom make replacements in kind, some other or different equipment or construction being usually necessary. It would be impossible to estimate years ahead what replacement costs are going to be, and in any event, it is fairly certain that investors in telephone securities are not primarily interested in property as such but are interested in safeguarding the money invested in the property which so far as it will some day be lost in operations, is therefore what should be covered by the depreciation provision.

#### RELATION OF CURRENT MAINTENANCE TO DEPRECIATION

We define depreciation for accounting purposes as the expense occasioned by the using up of physical property employed as fixed capital. This results in a complementary definition of current maintenance as the expense occasioned by keeping such physical property in condition necessary for continued use during its service life. These definitions seem to have the simplicity and clearness characteristic of good definitions. Of course, in practice some minor concession has to be made to economy and convenience. It is the aim of the accountants of the Bell System, as it is of accountants generally, to produce results as correct as possible with reasonable limitation of expenditure for accounts and records.



## UNITS OF PROPERTY

On this account it is the practice in specifying the items of property to be given depreciation treatment to exclude minor and inconsequential items which can be safely accounted for as part of or auxiliary to the items which are specified. For example: In the aerial cable plant, the main expenditure is for the aerial cable itself, while a minor part of the total cost is made up of suspension strand wire, clamps, rings and other hardware. The unit of property selected for depreciation purposes is: "One span of aerial cable"—one span being the length of cable suspended between two poles. If one or more spans of cable are retired, the cost of property lost is charged to the depreciation reserve and this charge covers the associated suspension strand, clamps, rings, etc. But if any amount of strand, clamps or rings is renewed to keep the composite cable structure in good working condition during the service life of the aerial cable which is the principal constituent of the structure, the charge is to current maintenance. It is not the custom to allow suspension strand and rings to remain standing in the plant after the retirement of the aerial cable which they were erected to support, but in the unlikely event that such items should so stand for a considerable time and be eventually retired by themselves, no retirement entry would be necessary for them, because the proper amount of such auxiliary items is included in the average retirement unit cost for the aerial cable.

## AVERAGE UNIT COSTS

Generally speaking, the retirement unit costs used in the Bell System are averages of original cost per unit, so calculated and recalculated currently that if, for example, all the units in the cable account with their associated elements were to be instantaneously retired from service, the accounting procedure would then and there empty the asset account for cable, leaving it at zero. This plan gives assurance, on the basis of aver-

ages, that no physical property costs remain in the asset accounts after the physical property itself has in fact gone out of service.

#### PROPERTY INDIVIDUALIZED

In the case of buildings, large switchboards and machines and certain other items which can be conveniently individualized for accounting purposes, actual original cost is maintained and it is not necessary to resort to the use of average costs.

#### ASCERTAINMENT OF SERVICE LIVES ON THE "GROUP" BASIS

A very important consideration in modern depreciation accounting is the problem of group treatment.

Our good accounting books tell us that the factors which enter into straight-line accounting for depreciation are, first, the cost of the property; second, the net salvage or junk value realizable upon the retirement of the property and third, the life in service, represented by the number of accounting periods within which the service life of the property is comprised. The proportion of expense chargeable to any single period is the consumable portion of original cost (total cost, less salvage) divided by the number of periods involved.

The amount of depreciation chargeable annually on this basis divided by the original cost of the depreciable property is the annual depreciation rate.

This is fairly simple, but a complex situation arises in actual practice because in large modern undertakings the items become so exceedingly numerous. For example, one of the large companies of the Bell System has over 721,020 poles, 12,000,000 conductor miles of wire and over 2,000,000 sets of subscribers' instruments.

It is impossible to deal with the individual service life of each item, such as a pole or a telephone instrument. It is necessary to study the behavior of large groups of such items.

THE "GROUP" BASIS

PRO FORMA CALCULATION OF GROUP DEPRECIATION RATE AND RESULTING ACCOUNTING TREATMENT

| UNITS | SERVICE<br>YEARS | UNIT<br>YEARS | YEAR  | INVEST-<br>MENT AT<br>BEGIN-<br>NING<br>OF YEAR<br>(a) | RETIRE-<br>MENTS<br>DURING<br>YEAR<br>(b) | AVERAGE<br>INVEST-<br>MENT<br>YEAR<br>(c) | ANALYSIS OF ENTRIES PASSING THROUGH<br>"DEPRECIATION RESERVE" ACCOUNT |                |               |                       |               | BALANCE |
|-------|------------------|---------------|-------|--------------------------------------------------------|-------------------------------------------|-------------------------------------------|-----------------------------------------------------------------------|----------------|---------------|-----------------------|---------------|---------|
|       |                  |               |       |                                                        |                                           |                                           | *                                                                     | ENTRIES        |               | ANNUAL NET CUMULATIVE |               |         |
|       |                  |               |       |                                                        |                                           |                                           |                                                                       | CREDITS<br>(d) | DEBITS<br>(e) | CREDITS<br>(f)        | DEBITS<br>(g) |         |
|       |                  |               |       |                                                        |                                           |                                           |                                                                       |                |               |                       |               |         |
| 5     | .5               | 2.5           | 1     | \$ 1,000                                               | \$ 5.00                                   | \$997.50                                  | \$ 99.75                                                              | \$ 5.00        | \$94.75       | \$                    | \$ 94.75      |         |
| 7     | 1.5              | 10.5          | 2     | 995                                                    | 7.00                                      | 991.50                                    | 99.15                                                                 | 7.00           | 92.15         |                       | 186.90        |         |
| 8     | 2.5              | 20.0          | 3     | 988                                                    | 8.00                                      | 984.00                                    | 98.40                                                                 | 8.00           | 90.40         |                       | 277.30        |         |
| 10    | 3.5              | 35.0          | 4     | 980                                                    | 10.00                                     | 975.00                                    | 97.50                                                                 | 10.00          | 87.50         |                       | 364.80        |         |
| 15    | 4.5              | 67.5          | 5     | 970                                                    | 15.00                                     | 962.50                                    | 96.25                                                                 | 15.00          | 81.25         |                       | 446.05        |         |
| 85    | 5.5              | 192.5         | 6     | 955                                                    | 35.00                                     | 937.50                                    | 93.75                                                                 | 35.00          | 58.75         |                       | 504.80        |         |
| 60    | 6.5              | 390.0         | 7     | 920                                                    | 60.00                                     | 890.00                                    | 89.00                                                                 | 60.00          | 29.00         |                       | 533.80        |         |
| 90    | 7.5              | 675.0         | 8     | 860                                                    | 90.00                                     | 815.00                                    | 81.50                                                                 | 90.00          |               | 8.50                  | 525.30        |         |
| 120   | 8.5              | 1,020.0       | 9     | 770                                                    | 120.00                                    | 710.00                                    | 71.00                                                                 | 120.00         |               | 49.00                 | 476.30        |         |
| 150   | 9.5              | 1,425.0       | 10    | 650                                                    | 150.00                                    | 575.00                                    | 57.50                                                                 | 150.00         |               | 92.50                 | 383.80        |         |
| 150   | 10.5             | 1,575.0       | 11    | 500                                                    | 150.00                                    | 425.00                                    | 42.50                                                                 | 150.00         |               | 107.50                | 276.30        |         |
| 120   | 11.5             | 1,380.0       | 12    | 350                                                    | 120.00                                    | 290.00                                    | 29.00                                                                 | 120.00         |               | 91.00                 | 185.30        |         |
| 90    | 12.5             | 1,125.0       | 13    | 230                                                    | 90.00                                     | 185.00                                    | 18.50                                                                 | 90.00          |               | 71.50                 | 113.80        |         |
| 60    | 13.5             | 810.0         | 14    | 140                                                    | 60.00                                     | 110.00                                    | 11.00                                                                 | 60.00          |               | 49.00                 | 64.80         |         |
| 35    | 14.5             | 507.5         | 15    | 80                                                     | 35.00                                     | 62.50                                     | 6.25                                                                  | 35.00          |               | 29.75                 | 36.05         |         |
| 15    | 15.5             | 232.5         | 16    | 45                                                     | 15.00                                     | 37.50                                     | 3.75                                                                  | 15.00          |               | 11.25                 | 24.80         |         |
| 10    | 16.5             | 165.0         | 17    | 30                                                     | 10.00                                     | 25.00                                     | 2.50                                                                  | 10.00          |               | 7.50                  | 17.30         |         |
| 8     | 17.5             | 140.0         | 18    | 20                                                     | 8.00                                      | 18.00                                     | 1.80                                                                  | 8.00           |               | 6.40                  | 10.90         |         |
| 7     | 18.5             | 129.5         | 19    | 12                                                     | 7.00                                      | 8.50                                      | .85                                                                   | 7.00           |               | 6.15                  | 4.75          |         |
| 5     | 19.5             | 97.5          | 20    | 5                                                      | 5.00                                      | 2.50                                      | .25                                                                   | 5.00           |               | 4.75                  |               |         |
| 1,000 | x                | 10,000.0      | TOTAL |                                                        | \$1,000.00                                |                                           | \$1,000.00                                                            | \$1,000.00     |               |                       |               |         |

\* CONTRA. OF CHARGES TO EXPENSE ACCOUNT "DEPRECIATION"

Fig. 5

The first step obviously is to make such division of the asset accounts into certain groups as will insure reasonable homogeneity in the groups. The Uniform System of Accounts does this. Pole Lines are in one account, Aerial Cables in another, Open Wire in another. Subscribers' station apparatus, private branch exchanges and telephone booths are each in a separate account.

Let us consider the pole line account. As soon as we propose an accounting on the basis of groups of poles, we are faced with the fact that of the poles going into the plant in any one year, some will have a much longer life than others. Some poles will be retired because of storms, others because of public convenience, others because of the substitution of underground for overhead distribution. There will be a wide dispersion of retirements.

We have also to consider that as soon as a pole is physically retired its cost must be removed from the fixed capital account and so the depreciation rate must be applied to a changing quantity of poles. As to the group of poles installed in any one year, it will be applied always to the remainder, continually growing less, of the original number of poles. The whole of the book account for poles will cover the remainders of many such groups of poles, one group for each year of original installation.

### *Analogy to Life Insurance*

The problem of determining average service lives for telephone plant where there is a substantial variation in age at retirement is similar to that of the life insurance actuary in determining the expectation of human life. The recorded experience upon which the studies of the life insurance actuary are based, covers large numbers of men. It shows, first, out of the total number of individuals constituting the group under observation how many were alive in each year of age



and therefore “exposed to the risk of dying,” to use an actuarial expression, during that year, and second, how many actually did die during each year of age. Based upon this information the life insurance actuary is able to compute rates of human mortality by age and from

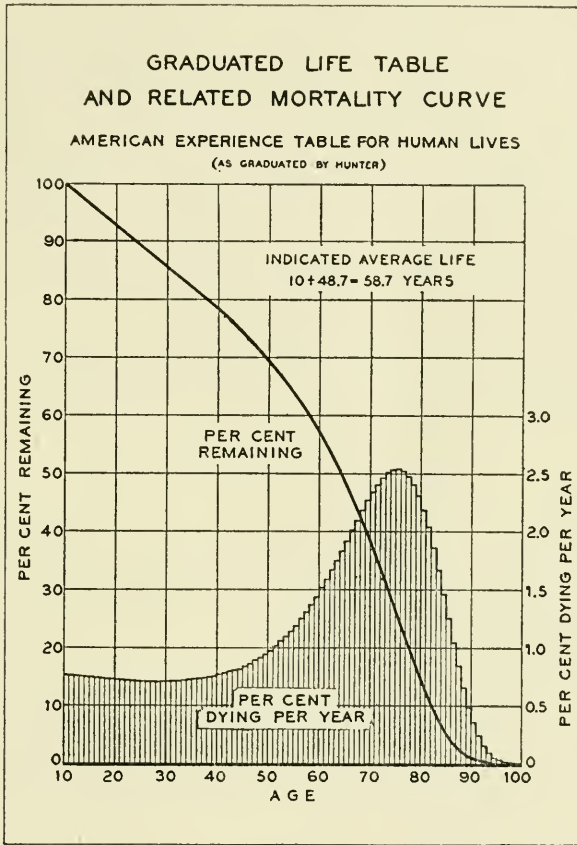


FIG. 6

these to determine the related expectation of life. This latter determination is based upon the calculation of a “Life Table” consisting of a series of figures which show for an initial group of individuals at a given age the number who will survive for each successive year of age thereafter.

The ratio between the number dying in any one year and the number exposed to the risk of dying, constitutes "the mortality rate" for that year of age. There is a well developed actuarial procedure by which a series of such mortality rates by age can be converted into a life expectancy for the group.

Data as to retirement experience similar to the experience analyzed by the life insurance actuary are available for several important classes of telephone plant, and it has therefore been natural to apply such actuarial methods of analysis in the determination of average service lives for those classes of plant. Extended application of those methods to thousands of telephone plant life tables has demonstrated conclusively that they are entirely suitable, and it has been found that each life table can be adequately described by a mathematical formula, whose constants are separately determined from each observed life table.

#### *Gompertz-Makeham Formula*

The formula involved was first given mathematical expression by two actuaries, Gompertz and Makeham, and is widely employed at the present time by life insurance actuaries in the graduation of life tables.

One of the interesting points about the use of this formula is that in spite of its complexity, its application has been reduced to a series of routine computations which can be carried out to completion by ordinary skilled comptometer operators, working under competent supervision.

As might be anticipated, the mortality rates for any given age are by no means identical for all classes of telephone property. Indeed, they are not the same for a single class of such property for various sections of the country, and even in a particular part of the country there may be a change in the rate as the environment of the plant undergoes a change. The flexibility of the Gompertz-Makeham formula is such, however,

## PRINCIPAL MATHEMATICAL FORMULAS

USED IN GRADUATION OF LIFE TABLES DEVELOPED FROM  
"FINAL SUMMARY OF HISTORICAL DATA FOR MORTALITY STUDY"

$$(1) \quad l_x = k s^x g^{c^x} \quad (\text{GOMPertz-MAKEHAM FORMULA})$$

$$(2) \quad \frac{t c^{t+\frac{1}{2}} - \frac{c^{t+\frac{1}{2}} - c^{\frac{1}{2}}}{c-1} c - (c-1) \left[ \frac{t^2}{2} + \frac{4t^3 - 3t^2 - t}{12} C_e \right]}{c^{t+\frac{1}{2}} - c^{\frac{1}{2}} - (c-1) \left[ t + \frac{t^2}{2} C_e \right]} = \frac{\sum_{x=0}^{t-1} x L_{x+\frac{1}{2}} - \frac{t^2}{2} L_0 - \frac{4t^3 - 3t^2 - t}{12} A}{\sum_{x=0}^{t-1} L_{x+\frac{1}{2}} - t L_0 - \frac{t^2}{2} A}$$

$$(3) \quad \log g = \frac{\sum_{x=0}^{t-1} L_{x+\frac{1}{2}} - t L_0 - \frac{t^2}{2} A}{c^{t+\frac{1}{2}} - c^{\frac{1}{2}} - (c-1) \left[ t + \frac{t^2}{2} C_e \right]} (c-1)$$

$$(4) \quad \log g = \frac{\sum_{x=0}^{t-1} x L_{x+\frac{1}{2}} - \frac{t^2}{2} L_0 - \frac{4t^3 - 3t^2 - t}{12} A}{t c^{t+\frac{1}{2}} - \frac{c^{t+\frac{1}{2}} - c^{\frac{1}{2}}}{c-1} c - (c-1) \left[ \frac{t^2}{2} + \frac{4t^3 - 3t^2 - t}{12} C_e \right]} (c-1)$$

$$(5) \quad \log s = A - C_e \log g$$

$$(6) \quad l_x = k s^x r^{x^2} g^{c^x} \quad (\text{EXTENDED GOMPertz-MAKEHAM FORMULA})$$

$$(7) \quad \frac{t c^{t+\frac{1}{2}} - \frac{c^{t+\frac{1}{2}} - c^{\frac{1}{2}}}{c-1} c - (c-1) \left[ \frac{t^2}{2} + \frac{4t^3 - 3t^2 - t}{12} C_e + \frac{t^2}{48} (6t^2 + 7t - 1) C_e^2 \right]}{c^{t+\frac{1}{2}} - c^{\frac{1}{2}} - (c-1) \left[ t + \frac{t^2}{2} C_e + \frac{4t^3 - 3t^2 - t}{24} C_e^2 \right]} = \frac{\sum_{x=0}^{t-1} x L_{x+\frac{1}{2}} - \frac{t^2}{2} L_0 - \frac{4t^3 - 3t^2 - t}{12} A - \frac{t^2}{48} (6t^2 + 7t - 1) B}{\sum_{x=0}^{t-1} L_{x+\frac{1}{2}} - t L_0 - \frac{t^2}{2} A - \frac{4t^3 - 3t^2 - t}{24} B}$$

$$(8) \quad \log g = \frac{\sum_{x=0}^{t-1} L_{x+\frac{1}{2}} - t L_0 - \frac{t^2}{2} A - \frac{4t^3 - 3t^2 - t}{24} B}{c^{t+\frac{1}{2}} - c^{\frac{1}{2}} - (c-1) \left[ t + \frac{t^2}{2} C_e + \frac{4t^3 - 3t^2 - t}{24} C_e^2 \right]} (c-1)$$

$$(9) \quad \log g = \frac{\sum_{x=0}^{t-1} x L_{x+\frac{1}{2}} - \frac{t^2}{2} L_0 - \frac{4t^3 - 3t^2 - t}{12} A - \frac{t^2}{48} (6t^2 + 7t - 1) B}{t c^{t+\frac{1}{2}} - \frac{c^{t+\frac{1}{2}} - c^{\frac{1}{2}}}{c-1} c - (c-1) \left[ \frac{t^2}{2} + \frac{4t^3 - 3t^2 - t}{12} C_e + \frac{t^2}{48} (6t^2 + 7t - 1) C_e^2 \right]} (c-1)$$

$$(10) \quad \log s = A - C_e \log g$$

$$(11) \quad \log r = \frac{1}{2} [B - C_e^2 \log g]$$

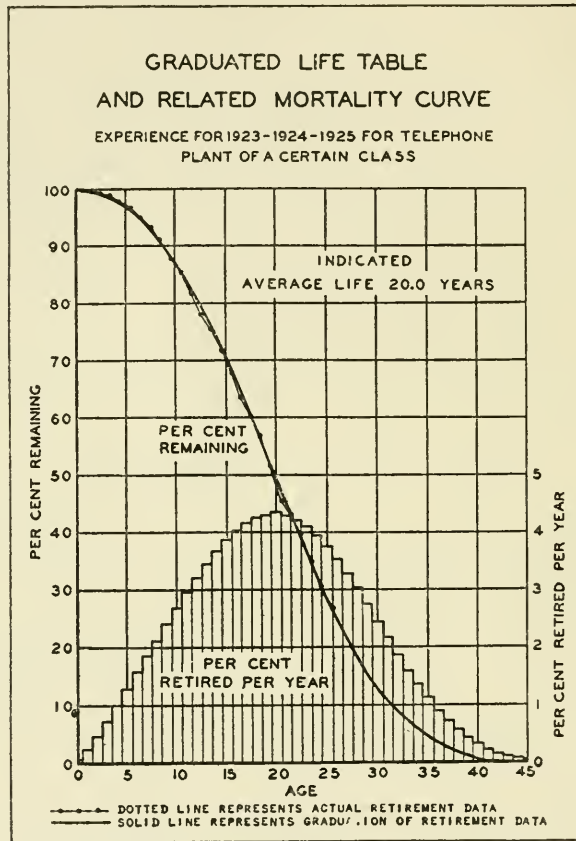
NOTE:  $A = \left[ \frac{dL_x}{dx} \right]_{x=0}$

$B = \left[ \frac{d^2 L_x}{dx^2} \right]_{x=0}$

OTHER CAPITAL LETTERS REPRESENT  
LOGARITHMS OF CORRESPONDING SMALL LETTERS.

Fig. 7

that no difficulty is introduced by these facts. A set of constants can be determined from the recorded observations, from which some one curve out of the infinite number of conceivable Gompertz-Makeham curves can be derived as representative of the mortality experience



**Fig. 8**

of property, of the class and in the situation under examination, and wherever the life history is not yet complete, this curve will provide a logical and scientific basis for projection of an observed life table out to its close.

One of the advantages of the actuarial method of



studying plant mortality is ability to bring the depreciation studies closely up-to-date.

*“Band” Analysis*

Owing to improvements in the telephone art, telephone companies are today obtaining a longer average life from many plant elements than was formerly the case. For this reason a study of the retirement experience in recent years is of especial significance and it is the practice to make concentrated study of portions of recorded experience, confined to a given strip or band of the tabular matter. Taking the band of say 1928 as an illustration: This would disclose the first years' retirements on plant installed one year ago, the second year's retirements on plant installed two years ago, the third year's retirements on plant installed three years ago, and so on backward, say to the thirtieth and final years' retirements on plant installed thirty years ago and now completely retired.

The band study substitutes for the complete analysis of say, 30 years' experience of one group, an analysis of one year's experience with say 30 groups, each group successively one year later in time of installation than its next predecessor group. One study scans, as it were, the warp while the other scans the woof, of the statistical fabric.

The advantages gained are first, the greater reliability of the most recent records, and second, the reflection in the results of the most recent company policy and plant administrative technique.

The two sorts of studies mentioned may be made in conjunction, the results compared and their mutual consistency derived. In practice, studies are not ordinarily made of bands for a period so short as one year. Three years is generally as narrow a band as the quantity of data will justify as adequate. The bands may be selected so as to overlap; for example having analyzed the 1915-17 band, the next band taken may be 1916-18, then 1917-19 and so on.

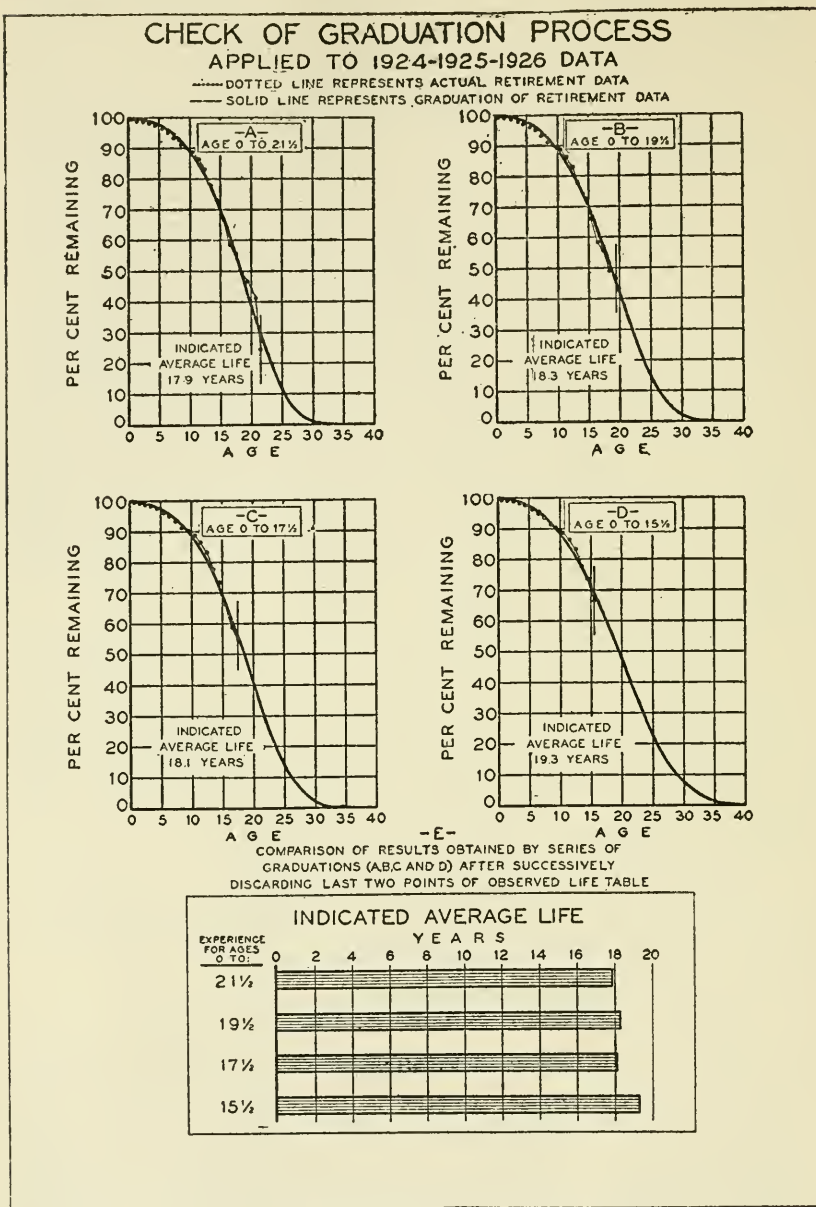


FIG. 9

*Turn-over Method*

For certain classes of telephone property, the actuarial method just described cannot be employed in practice on account of technical difficulties and expense in the collection of data.

For these classes, an alternative method of procedure is employed, which has been denominated the "turn-over method." Those familiar with life insurance will understand at once the fundamental principle of the turn-over plan when we say that it is the same as that which is involved in the relation of total deaths of human beings of all ages to exposed population of all ages in a non-growing community.

The accounts of the telephone companies are kept to show separately the amount of plant of each class going new into the plant in any year and the amount of old plant of each class retired from service in any year.

If the class of plant were to remain stationary in amount and stable in its life characteristics and age distribution, the average time that plant remained in service could be readily ascertained from a relation of either the retirements or the replacements to the total plant. Either the length of the period of time required for the most recent replacements to accumulate to the amount of the plant at the end of that period or the length of the period of time required for the retirements to accumulate backwards in time to the amount of the plant at the beginning of that period—the two periods being the same—would be the length of the life of plant of the given class, on the average.

Determination of the average life of telephone property on this basis is made difficult by several conditions; viz.:

- a* Changes in the life characteristics of plant which occur during the period studied.
- b* Changes in the purchasing power of the dollars, in which the books are kept, whereby a given number of dollars may represent more or less plant than formerly.

# EXAMPLE TO ILLUSTRATE PRINCIPLE OF TURNOVER METHOD

PLANT GROWING AT THE RATE OF 10% ANNUALLY  
DATA IN TERMS OF PLANT COSTS — AVERAGE LIFE OF UNITS 10 YEARS

## TABLE OF PLANT UNITS AND COSTS

| YEAR | PLANT PLACED    |            |            | PLANT RETIRED   |            |            |                                  | PLANT IN SERVICE JANUARY 1ST |            |
|------|-----------------|------------|------------|-----------------|------------|------------|----------------------------------|------------------------------|------------|
|      | NUMBER OF UNITS | UNIT COSTS | TOTAL COST | NUMBER OF UNITS | UNIT COSTS | TOTAL COST | TOTAL COST ACCUMULATED FROM 1926 | NUMBER OF UNITS              | TOTAL COST |
|      | 1               | 2          | 3          | 4               | 5          | 6          | 7                                | 8                            | 9          |
| 1913 | 50,545          | \$1.00     | \$50,545   | 20,826          | \$1.00     | \$20,826   |                                  | 292,982                      | \$292,982  |
| 1914 | 55,599          | .90        | 50,039     | 23,110          | 1.00       | 23,110     |                                  | 322,701                      | 322,701    |
| 1915 | 61,159          | 1.10       | 67,275     | 25,539          | 1.00       | 25,539     |                                  | 355,190                      | 349,630    |
| 1916 | 67,275          | 1.60       | 107,640    | 28,163          | 1.00       | 28,163     |                                  | 390,810                      | 391,366    |
| 1917 | 74,003          | 1.80       | 133,205    | 31,010          | 1.00       | 31,010     |                                  | 429,922                      | 470,843    |
| 1918 | 81,403          | 1.65       | 134,315    | 34,112          | 1.00       | 34,112     | \$ 602,491                       | 472,915                      | 573,038    |
| 1919 | 89,543          | 1.40       | 125,360    | 37,523          | 1.00       | 37,523     | 568,379                          | 520,206                      | 673,241    |
| 1920 | 98,497          | 1.60       | 157,595    | 41,273          | 1.33       | 54,893     | 530,856                          | 572,226                      | 761,078    |
| 1921 | 108,347         | 1.30       | 140,851    | 45,404          | 1.37       | 62,203     | 475,963                          | 629,450                      | 863,780    |
| 1922 | 119,182         | 1.25       | 148,978    | 49,942          | 1.36       | 67,921     | 413,760                          | 692,393                      | 942,428    |
| 1923 | 131,100         | 1.35       | 176,985    | 54,935          | 1.34       | 73,613     | 345,839                          | 761,633                      | 1,023,485  |
| 1924 | 144,210         | 1.40       | 201,894    | 60,429          | 1.35       | 81,579     | 272,226                          | 837,798                      | 1,126,857  |
| 1925 | 158,631         | 1.55       | 245,878    | 66,475          | 1.35       | 89,741     | 190,647                          | 921,579                      | 1,247,172  |
| 1926 | 174,494         | 1.50       | 261,741    | 73,120          | 1.38       | 100,906    | 100,906                          | 1,013,735                    | 1,403,309  |
| 1927 | -               | -          | -          | -               | -          | -          | -                                | 1,115,109                    | 1,564,144  |

## APPLICATION OF TURNOVER METHOD

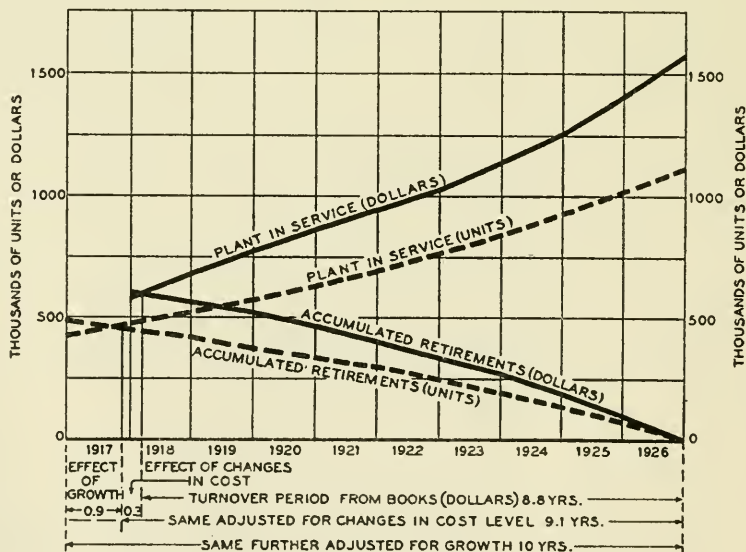


FIG. 10



- c Growth, positive or inverse, in the total plant of the given class during and preceding the period studied, which disturbs the mortality ratio. When retirements are studied, for example, positive growth introduces the condition that some of low age mortalities of the added plant which produces the growth enter the results as a disturbing element.
- d Purchases and sales of telephone plant from one company to another. These transactions operate like sudden growth.

None of these difficulties is insuperable. The changes in the characteristics of plant may be fairly well recognized. The changes in the value of money can be compensated by placing the study upon an "index number" basis. Suitable methods have been developed to make allowance for the effect upon the turn-over period of such growth as may have taken place.

The turn-over method while theoretically inferior to the actuarial method has been found practically very useful and dependable.

#### SPECIAL CASES—BUILDINGS AND CENTRAL OFFICE EQUIPMENT

For two classes of telephone property, buildings and central office telephone equipment, we find that the best way to estimate the depreciation rates is to forecast how long, in view of population growth and the progress of the service, existing buildings and equipment will individually serve to meet the needs of the community.

The long-term basis upon which plant of these classes is engineered is such that forecasts of this sort can be made with a reasonable approach to accuracy and in the case of central office telephone equipment, the existence of a condition peculiar to such equipment should be mentioned.

Central Office telephone equipment is usually not installed to the full capacity of the Central Office at the time of initial provision of such equipment. A certain

quantity of equipment is installed sufficient to provide service for a given number of years and is added to from time to time as demand increases, the later equipment being commingled with the earlier.

We thus have a problem of growing property structures, wherein the weighted average age of the com-

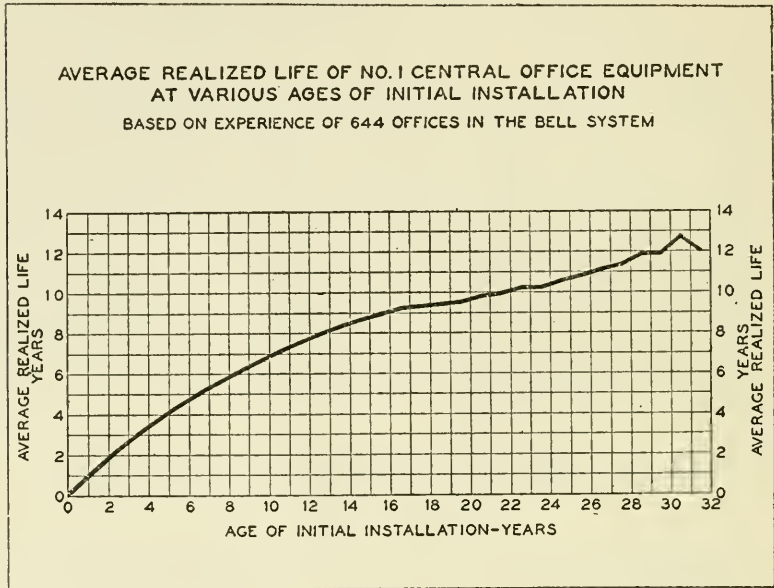


FIG. 11

ponent units of the structures is much less than the overall age of the structures as operative entities.

Some interesting investigations have demonstrated the relation of average realized life of Central Office equipment to age of initial installation for various ages of the latter, and it has been found that the engineering economics in the advance provision of this class of property set rather definite limitations to the average life of the composite structures, even though the age of the first and oldest portions of the structures may be very lengthy.

In the ordinary classes of telephone property we have groups of homogeneous units, the components of

## *Straight-Line Depreciation Accounting Practice*

which arrive together in a given year but gradually and variously waste away.

In the case of Central Office telephone equipment, we have the rather unusual phenomenon of groups of

SOME CAUSES OF ORDINARY DEPRECIATION OF TELEPHONE PLANT  
AND ILLUSTRATIONS OF THEIR EFFECTS

| CAUSES OF DEPRECIATION       | KIND OF DEPRECIATION (PREDICTABLE EFFECT) | PLANT CHARACTERISTICS AFFECTED | ILLUSTRATIVE CASES                                                                   |
|------------------------------|-------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------|
| ACTION OF ELEMENTS           | ROT, RUST AND DECAY                       | PHYSICAL CONDITION             | DETERIORATION OF WIRE,                                                               |
| ORGANIC AGENCIES             | ROT, RUST AND DECAY                       | PHYSICAL CONDITION             | ROTTING OF POLES                                                                     |
| USE IN OPERATION             | WEAR AND TEAR                             | PHYSICAL CONDITION             | DETERIORATION OF AUTOMOBILES IN USE                                                  |
| INJURY                       | WEAR AND TEAR                             | PHYSICAL CONDITION             | UNDERGROUND CABLE INJURED BY WORKMAN'S PICK                                          |
| STORMS AND CASUALTIES        | WEAR AND TEAR                             | PHYSICAL CONDITION             | POLES DESTROYED BY SLEET STORM                                                       |
| IMPROVEMENTS IN THE ART      | OBSOLESCENCE                              | FUNCTION                       | SUBSTITUTION OF CALL INDICATOR POSITIONS FOR MANUAL "B" POSITIONS IN CENTRAL OFFICES |
| GROWTH OF COMMUNITIES SERVED | INADEQUACY                                | CAPACITY                       | SUBSTITUTION OF A LARGER UNIT, SUCH AS A SWITCHBOARD OR CABLE                        |
| MORE INTENSIVE SERVICE       | INADEQUACY                                | CAPACITY                       | SUBSTITUTION OF A LARGER UNIT, SUCH AS A SWITCHBOARD OR CABLE                        |
| FIRES                        | DAMAGE                                    | PHYSICAL CONDITION             | BURNING OF STATION APPARATUS IN A BUILDING FIRE                                      |
| ADVANCING SOCIAL STANDARDS   | PUBLIC REQUIREMENTS                       | CHARACTER AND LOCATION         | LINES RETIRED BECAUSE OF PUTTING WIRES UNDERGROUND ON THOROUGHFARES                  |
| PUBLIC CONVENIENCE           | PUBLIC REQUIREMENTS                       | CHARACTER AND LOCATION         | POLES RETIRED BECAUSE OF HIGHWAY CHANGES                                             |

FIG. 12

units which arrive from time to time and are completed in a single structure, no part of which is separable for depreciation purposes because of the mutuality of relation of all of the parts, regardless of age, the entire structure being eventually retired en bloc.

“ORDINARY DEPRECIATION” VS. “EXTRAORDINARY DEPRECIATION”

In the studies and projections previously referred to, we have been concerned with losses caused by what is generally termed “Ordinary Depreciation.” However, there may be certain other operating losses, to which we have not heretofore referred, that might well be classed as “Extraordinary Depreciation.”

Fundamental accounting considerations lead us to distinguish four kinds of losses:

First: Losses such as customarily result from the devotion of perishable plant to service through wear and tear, storms and other casualties, inadequacy, obsolescence, etc.; that is, “ordinary depreciation.” Reasonable prudence demands proper and adequate provision for the full amount of such losses.

Second: Losses, not the ordinary outcome of use in operations but which are known from the nature of the property, to be at times the outcome of a definite hazard of employment, for example, destruction by fire. Prudence makes such provision proper as is dictated by the nature and extent of the hazard and the contingency of depreciation loss. (In the case of the Bell System, because of the nature of the property and the extraordinary precautions taken to protect the service against interruption, fire losses not covered by underwritten insurance have been of such extremely minor consequence that we prefer to consider them as covered in our provision for ordinary depreciation.)

Third: Extraordinary losses which are not common to the particular property and do not flow from the ordinary hazards of employment, which prudence does not require us to anticipate but which are nevertheless conceivable and for which the accounting system must afford the means of possible depreciation treatment. Losses due to earthquake or war or to some unforeseen revolutionary invention would come under this class. Such losses are too uncertain and remote to admit of advance provision being made by any method sufficiently definite to warrant inclusion of charges as operating expenses and, under these conditions, the blow to the assets, should it occur, must be met temporarily by the company's exist-



ing surplus, which ought to be maintained, among other things, to enable the company to outride the financial troubles induced by such unforeseen events. Their amortization must be accomplished after the event and in the telephone business we consider that it would be good accounting in order not to distort the current accounting of the time when the blow fell, to charge such losses initially to suspense and to amortize the amount involved, by installment charges, over a reasonable period of time, in a separate account under Operating Expenses to be entitled "Extraordinary Depreciation." If revenues during this process are sufficient for the purpose, the gradual accumulation in the undertaking of additional assets equivalent to the amortization installments will eventually effect a restoration of the surplus.

The fourth species of loss is that which does not affect merely individual items of plant or equivalent in a continuing industry so much as it attacks the industry as a whole. For example, there was the supersession of the wooden ship building industry when iron ships made their appearance. There was the destruction of many bicycle businesses when the automobile arrived. The risk of losses of this sort, which cripple or destroy an industry, not merely items of its equipment, must be covered, if at all, out of current profits. Such risk is one of the general hazards of business to be considered in determining what is an acceptable return from the enterprise.

With this understanding of the limitations of ordinary depreciation accounting, we may say that it covers the losses that culminate upon the retirement of property from service which are occasioned by causes known to become operative in the ordinary conduct of the undertaking and the effects of which can be forecast.

The fact that no account is taken by telephone companies of the possibility of something extraordinary happening does not mean that the eyes of telephone accountants are shut to that possibility. We simply resolve our doubts in favor of a longer rather than a shorter life, until the unforeseen shall occur.

## FORECASTING SERVICE LIFE AND SALVAGE OF EXISTING PROPERTY

The problem of forecasting ordinary life and salvage of telephone plant is not a difficult problem, as business and accounting problems go nowadays. It requires sufficient data, drawn largely from past experience, and the consideration and judgment of competent experts.

The telephone business has certain peculiarities which favor the correct determination of the depreciation factors of service life and salvage.

A telephone company undertakes the provision of the entire service within an area. It operates without competition of similar companies. There is a direct relation between the spread of its service and the growth of population. Telephone plant is so costly and the importance of locating central offices and distributing systems economically with reference to the spread of communities is so immense, that it is the custom of telephone engineers to prepare and continuously maintain for the exchange plants of urban centers and for toll systems, "Fundamental Plans" which look ahead for a certain number of years and furnish a dependable conspectus of the telephone situation, present and prospective, in the area.

### LONG-LIVED PROPERTY

Certain long-lived properties, such as main conduit runs and buildings of the typical American monumental type offer points of difficulty as to probable service life. The judgment of experts is of special value here and there is always opportunity to restudy the matter as the age of the units increases and the engineers obtain a farther view into the future through the Fundamental Plans. The eventual retirement of such property can be forecast as most probable, therefore a reasonable estimate—even though containing a margin of error—keeps the accounts more nearly cor-

| ILLUSTRATION OF METHOD OF DETERMINING ANNUAL DEPRECIATION EXPENSE |             |                                 |                    |                      |             |                 |                       |                 |                                                  |                                             |
|-------------------------------------------------------------------|-------------|---------------------------------|--------------------|----------------------|-------------|-----------------|-----------------------|-----------------|--------------------------------------------------|---------------------------------------------|
| CLASS OF PROPERTY<br>1                                            | COST<br>2   | AVERAGE SERVICE LIFE YEARS<br>3 | GROSS SALVAGE<br>4 | COST OF REMOVAL<br>5 | NET SALVAGE |                 | PROPERTY COST USED UP |                 | ANNUAL DEPR. RATE PER CENT (COL.9 ÷ COL.3)<br>10 | ANNUAL DEPR. EXPENSE (COL.2 × COL.10)<br>11 |
|                                                                   |             |                                 |                    |                      | AMOUNT<br>6 | % OF COL.2<br>7 | AMOUNT<br>8           | % OF COL.2<br>9 |                                                  |                                             |
| BUILDINGS                                                         | \$ 82,000   | 30                              | \$ 32,800          | \$ 15,680            | \$ 32,800   | 40              | \$ 49,200             | 60              | 2                                                | \$ 1,640                                    |
| CENTRAL OFFICE EQUIPMENT                                          | 196,000     | 13                              | 47,040             |                      | 31,360      | 16              | 164,640               | 84              | 6.5                                              | 12,740                                      |
| STATION APPARATUS                                                 | 78,000      | 5                               | 54,600             |                      | 54,600      | 70              | 23,400                | 30              | 6                                                | 4,680                                       |
| PRIVATE BRANCH EXCHANGES                                          | 32,000      | 6                               | 22,080             | 1,600                | 20,480      | 64              | 11,520                | 36              | 6                                                | 1,920                                       |
| BOOTH'S                                                           | 4,000       | 6                               | 2,760              | 200                  | 2,560       | 64              | 1,440                 | 36              | 6                                                | 240                                         |
| EXCHANGE POLE LINES                                               | 67,000      | 13                              | 24,320             | 9,600                | 14,720      | 23              | 67,000                | 100             | 8                                                | 5,360                                       |
| EXCHANGE AERIAL CABLE                                             | 84,000      | 14                              | 21,200             | 7,950                | 13,250      | 25              | 49,280                | 77              | 5.5                                              | 3,520                                       |
| EXCHANGE AERIAL WIRE                                              | 53,000      | 11                              |                    |                      |             |                 | 39,750                | 75              | 6.8                                              | 3,604                                       |
| EXCH. UNDERGROUND COND.                                           | 82,000      | 50                              |                    |                      |             |                 | 82,000                | 100             | 2                                                | 1,640                                       |
| EXCH. UNDERGROUND CABLE                                           | 110,000     | 18.5                            | 55,000             | 16,500               | 38,500      | 35              | 71,500                | 65              | 3.5                                              | 3,850                                       |
| EXCH. SUBMARINE CABLE                                             | 1,300       | 12.5                            |                    |                      |             |                 | 1,300                 | 100             | 8                                                | 104                                         |
| TOLL POLE LINES                                                   | 75,000      | 16.5                            |                    |                      |             |                 | 75,000                | 100             | 6.1                                              | 4,575                                       |
| TOLL AERIAL CABLE                                                 | 10,000      | 14                              | 4,500              | 1,500                | 3,000       | 30              | 7,000                 | 70              | 5                                                | 500                                         |
| TOLL AERIAL WIRE                                                  | 77,000      | 20                              | 34,850             | 11,550               | 23,100      | 30              | 53,900                | 70              | 3.5                                              | 2,695                                       |
| TOLL UNDERGROUND COND.                                            | 9,000       | 60                              |                    |                      |             |                 | 9,000                 | 100             | 1.7                                              | 153                                         |
| TOLL UNDERGROUND CABLE                                            | 19,000      | 25                              |                    |                      |             |                 | 11,400                | 60              | 2.4                                              | 456                                         |
| TOLL SUBMARINE CABLE                                              | 1,000       | 12.5                            | 10,450             | 2,850                | 7,600       | 40              | 1,000                 | 100             | 8                                                | 80                                          |
| FURNITURE AND FIXTURES                                            | 7,000       | 10                              | 1,400              |                      | 1,400       | 20              | 5,600                 | 80              | 8                                                | 560                                         |
| SHOP EQUIPMENT                                                    | 100         | 10                              | 20                 |                      | 20          | 20              | 80                    | 80              | 8                                                | 8                                           |
| STORE EQUIPMENT                                                   | 600         | 10                              | 120                |                      | 120         | 20              | 480                   | 80              | 8                                                | 48                                          |
| GARAGE EQUIPMENT                                                  | 8,000       | 5                               | 2,000              |                      | 2,000       | 25              | 6,000                 | 75              | 15                                               | 1,200                                       |
| TOOLS AND IMPLEMENTS                                              | 4,000       | 4                               | 800                |                      | 800         | 20              | 3,200                 | 80              | 20                                               | 800                                         |
| RIGHT OF WAY - EXCH.                                              | 5,000       | 30                              |                    |                      |             | 0               | 5,000                 | 100             | 3.3                                              | 165                                         |
| RIGHT OF WAY - TOLL                                               | 7,000       | 40                              |                    |                      |             | 0               | 7,000                 | 100             | 2.5                                              | 175                                         |
| INTEREST DURING CONSTR.                                           | 8,000       | 40                              |                    |                      |             | 0               | 8,000                 | 100             | 5.1                                              | 409                                         |
| TOTAL                                                             | \$1,000,000 |                                 | \$313,740          | \$67,430             | \$246,310   |                 | \$ 753,690            |                 |                                                  | \$ 51,122                                   |

- COMPOSITE RATE -  
(A) TOTAL INVESTMENT \$1,000,000 (B) TOTAL ANNUAL DEPRECIATION EXPENSE \$51,122  
(C) COMPOSITE DEPRECIATION RATE (B ÷ A) 5.11%

Fig. 13

rect from year to year than if a heavy retirement liability be conveyed to the future without any provision to meet it.

#### SALVAGE

The factor of salvage in telephone depreciation has been successfully dealt with in practice. A study recently made of plant retired, salvage on which was allowed for in the computation of depreciation rates to the amount of \$122,594,000, revealed that the net salvage actually realized was \$122,499,000. The chief problem in the treatment of salvage, especially for the longer-lived property, is one of secular variation in cost levels. Index number studies are very helpful in interpreting the records of the past as shown in the accounts. Existing market prices of junk material are helpful. Price changes in the future may properly be considered, if a fairly definite forecast can be made, but resort to speculation is not advisable.

#### THE RÔLE OF JUDGMENT

The proper interpretation of the data regarding plant life and salvage obtainable from accounts, records and statistics is of equal importance with the integrity of the data themselves. It would seem that we should have first: investigations of past service life and salvage through sound accounting and statistical methods; second: investigations of the conditions surrounding the employment of such plant in the past and of the extent to which such conditions still prevail; third: the best possible forecast of conditions looming in the future which should exert a modifying influence upon either life or salvage. And then, the active judgment which fuses the experience of the past, so far as it is still pertinent, and the expectation for the future, so far as it is presently pertinent, into a just and reasonable determination of the current rate of depreciation for the time being.

The ascertainment and interpretations of the facts



and the making of the expert opinions and estimates must be undertaken by persons thoroughly familiar with the property and conversant with the future plans of the management. The company's future policy and program are intimately bound up with this undertak-

| DEPRECIATION RATES FOR A LARGE TELEPHONE COMPANY IN THE UNITED STATES |                      |
|-----------------------------------------------------------------------|----------------------|
| PORTION OF PROPERTY                                                   | DEPRECIATION RATES % |
| EXCHANGE RIGHT-OF-WAY . . . . .                                       | 5.0                  |
| TOLL RIGHT-OF-WAY . . . . .                                           | 2.5                  |
| BUILDINGS . . . . .                                                   | 2.1                  |
| C.O.EQUIPMENT-MANUAL . . . . .                                        | 8.5                  |
| - PANEL . . . . .                                                     | 6.0                  |
| - STEP-BY-STEP. . . . .                                               | 6.0                  |
| OTHER EQUIPMENT OF C.O. . . . .                                       | 8.0                  |
| STATION APPARATUS . . . . .                                           | 4.5                  |
| STATION INSTALLATIONS . . . . .                                       | 1.0                  |
| INTERIOR BLOCK WIRES . . . . .                                        | 4.0                  |
| PRIVATE BRANCH EXCHANGES . . . . .                                    | 5.0                  |
| BOOTHs AND SPECIAL FITTINGS . . . . .                                 | 3.6                  |
| EXCHANGE POLE LINES . . . . .                                         | 7.5                  |
| EXCHANGE AERIAL CABLE . . . . .                                       | 6.2                  |
| EXCHANGE AERIAL WIRE . . . . .                                        | 7.6                  |
| EXCHANGE UNDERGROUND CONDUIT - MAIN . . . . .                         | 2.0                  |
| - SUBSIDIARY . . . . .                                                | 4.0                  |
| EXCHANGE UNDERGROUND CABLE -MAIN . . . . .                            | 2.5                  |
| -SUBSIDIARY . . . . .                                                 | 6.0                  |
| EXCHANGE SUBMARINE CABLE . . . . .                                    | 7.0                  |
| TOLL POLE LINES . . . . .                                             | 6.0                  |
| TOLL AERIAL CABLE . . . . .                                           | 4.0                  |
| TOLL AERIAL WIRE . . . . .                                            | 4.8                  |
| TOLL UNDERGROUND CONDUIT . . . . .                                    | 2.0                  |
| TOLL UNDERGROUND CABLE . . . . .                                      | 2.5                  |
| TOLL SUBMARINE CABLE . . . . .                                        | 7.0                  |
| OFFICE FURNITURE AND FIXTURES . . . . .                               | 7.0                  |
| COMPOSITE RATE FOR COMPANY . . . . .                                  | 5.05                 |

FIG. 14

ing. Fundamentally, the determination of the proper rate is a problem of management; there can be no machine solution of it.

### THE DEPRECIATION RESERVE ACCOUNT

Passing now to another phase of the subject; i.e., the depreciation reserve account in the balance sheet,

which arises as a result of the accrued depreciation charges in the Income Statement.

In its origin, the "Reserve for Depreciation" account is merely the reflection under a system of double entry bookkeeping of what remains in the liabilities from the past charges for depreciation expense. The entry of prime importance is the charge to expense, which could be made equally as well under single entry bookkeeping; such a charge would be sufficient in itself to insure correct accounting. The expense charge serves the fundamentally important and useful purpose of debiting to any year or other accounting period recognized by the accounting, one of the costs of rendering telephone service during that period, namely the expense of depreciation. The total cost of that service cannot be inclusive without the item of depreciation. Along with this fundamental proposition of stating depreciation costs in periods in which they should be stated in order that the expense accounts may reflect true costs, goes the point that this procedure has the advantage of substantially equalizing the effect of property retirements. It is, of course, desirable that there be reasonable equalization, but this effect of depreciation accounting is merely a collateral effect of steps taken primarily to accomplish the purpose of spreading the retirement costs equitably over the service life to the depreciating property.

However, because double entry bookkeeping is employed and because the balance sheets of corporations which have become so important in modern times are a product of the double entry system, the reserve for depreciation, as a liability account, of itself comes to serve some important and useful purposes.

#### ADVANTAGES OF RESERVE ACCOUNTING

As an accounting consideration, the reserve account exhibits the accumulating provision for retirement of existing plant, which remains after charging off the loss

on items that have already been retired from service. In the same way, the reserve of a life insurance company represents the provision for meeting the accumulating liability which will mature upon the death of its policyholders.

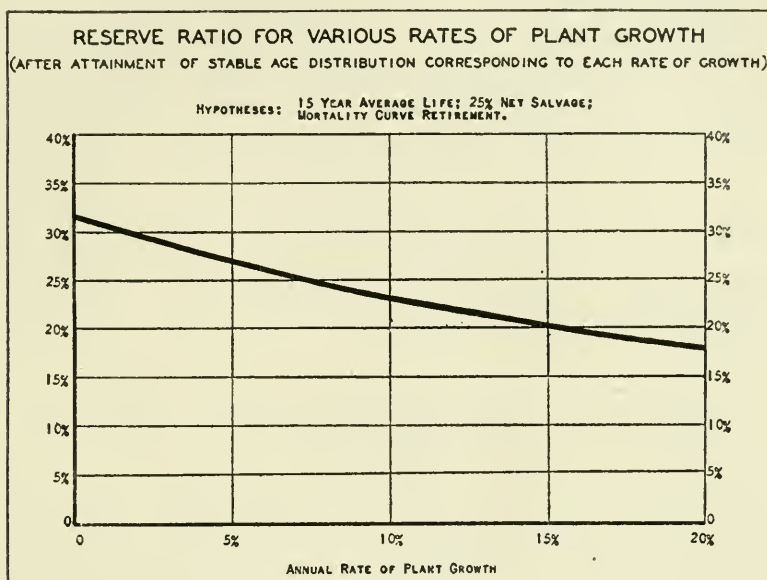


FIG. 15

As business considerations, several advantages of the reserve account appear. An adequate reserve account appearing in the balance sheet is a sign that the integrity of the company's assets is being maintained. The appearance of the account in this way before investors assists the companies to attract capital for extensions and betterments on favorable terms and as a result of these features, the depreciation reserve account assists a company to maintain service to its users with economy and in a high-grade manner.

#### ACCURACY OF THE RESERVE ACCOUNT

In the course of years the reserve account assumes a prominent place in the balance sheet, and sooner or

later it may become a matter of concern to know that it is reasonably correct. For this reason a knowledge of the characteristics of reserve growth is important. For any particular group of property installed at a given time the reserve account must, of course, increase steadily at first, reaching its maximum in dollars about the time of the average life and its maximum as a per cent. of the property to which it relates immediately before retirement of those components of the group which achieve the longest individual lives.

For all groups of a homogeneous class taken together, the reserve account will exhibit a condition which is dependent upon the complex of the successive groups, upon their relative volume and upon their appearance and disappearance in time with respect to each other.

#### THEORY OF THE RESERVE ACCOUNT IN GROWING PROPERTIES

The introduction of new groups into the class will decrease the reserve ratio: the ratio of the amount of the reserve account to the amount of the property class. Reserve ratios are lower in growing than in non-growing properties, other conditions being the same. Disregarding oscillations, a long continued uniform rate of growth tends to produce a stabilization of the reserve ratio, at a point dependent upon the particular rate of growth. If the rate of growth later increases, the reserve ratio becomes lower and will tend to stabilize at the lower figure as long as the higher rate of growth continues.

#### THEORY OF RESERVE ACCOUNT IN NON-GROWING PROPERTIES

A condition of non-growth in a continuing property eventually brings about, after a stable age distribution is achieved, a reserve ratio at the highest point obtainable in a non-disappearing plant with stable age distri-



bution. If units were always retired at the point of the average life (i.e. if they all had the same age at time of retirement), this highest ratio would be, with no salvage .50, or, with salvage, one-half of the sum derived by subtracting the ratio of salvage from 1.00, but with distributed retirements, the highest ratio must always be less than .50, for the loss of those members of the group which perish before the term of the average life occasions a greater reduction, percentagewise, in the reserve account to which their loss is charged than in the property from which their original cost is subtracted.

#### EFFECTS OF GROUP BASIS OF ACCRUAL

Group accrual does not provide for the entire loss of short-lived components during their individual lives; the accrual must be carried out on the longer-lived components to the end of their lives and beyond the mid-point representing the average life of all components, in order to provide for the entire loss of the group as such. For this reason, it is not possible to reckon up from an examination of the ages of items presently in service how much should stand in the reserve account in respect of such items.

#### RETIREMENT EXPENSE LESS THAN DEPRECIATION IN GROWING PROPERTIES

A knowledge of the characteristics of the ratios of current annual retirements (which are the annual gross debits to the reserve account), to the straight-line accruals for depreciation in the same year is also desirable.

In a growing plant, the annual retirement losses will be less than the current true annual expense of depreciation and the greater the rate of growth, the smaller the retirement losses will appear in comparison with the current depreciation rate, the reason being, of course, that in a growing plant there are new plant groups in operation on which depreciation is accruing

but which are not yet represented, or are but slightly represented, in the retirement losses. If we conceive of a rapidly growing plant in three successive stages of its existence, such stages being representative of a period of turnover of the plant, designated A, B and C, then, speaking in averages, the retirements during B will relate for the most part to the smaller plant A,

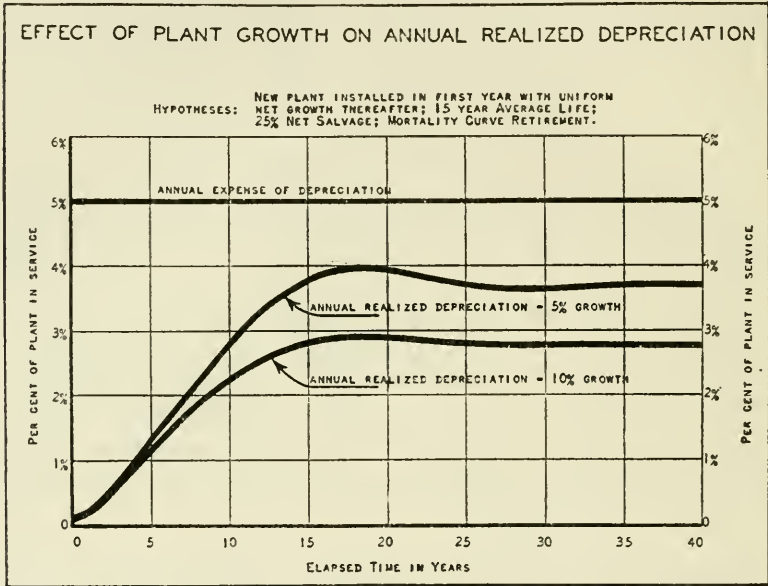


FIG. 16

while the depreciation reserve account is currently building up to meet the greatly increased eventual retirement liability of B. Similarly in period C retirements will relate to the smaller plant B, while the accruals now relate to the greater plant C. For this reason any attempt to ascertain percentages of current depreciation expense to investment in a growing property by dividing the average retirement losses by the average plant in service during the period within which such losses culminate, involves a mathematical fallacy.

## OBSTACLES TO EMPLOYMENT OF STRAIGHT-LINE METHOD

In all that has been said so far, the practicability and indeed the desirability of the straight-line method for depreciation expense accounting has been taken for granted, but obstacles to the use of this method undoubtedly exist in some cases. The obstacles usually appearing are:

*Inability to set up a line of demarcation between current maintenance and depreciation.* It would seem possible generally, though perhaps not universally, to overcome this difficulty by the adoption of a system of units of property, the retirement of which would be depreciation, work on which while in service, including replacements of parts, would be current maintenance. Under this plan, minor parts would be charged as depreciation only as originally embodied in the unit of which they were a part at the time of its installation and would be written off to reserve as an undivided part of the retirement loss of the unit, when the unit is removed or abandoned.

*Difficulties in forecasting service life.* This obstacle may in some cases appear serious, but in most instances it is unduly magnified. Most accountants probably would agree that the difficulty of accounting does not warrant entire neglect of accruing depreciation. It is the duty of a company to manage its business well and sound management may require, in many cases, ample provision for an inevitable loss, uncertain merely as to the time of its incidence. If provision should be made on some basis, probably a straight-line treatment, even with a considerable margin of error in the initial assumptions, would be reasonable, the matter to be periodically re-examined. Is it not a good rule that where difficulties in ascertaining accounting values are largely inherent in the nature of the subject-matter, the accounting should nevertheless go forward, the factors involved to be determined arbitrarily by the use of judgment, as nearly as may be?

In a number of industries, it has been considered that the straight-line method does not afford sufficient protection against unanticipated depreciation, due to unforeseen progress in the art, exigencies of competition, etc., and the reducing balance method has been adopted. One factor here is whether the nature of the enterprise is such that amortization in arrears of extraordinary casualty damage, sudden major obsolescence or losses on unanticipated reconstruction, is possible without too great risk or detriment. Certainly, risky and uncertain enterprises and those in a rapidly evolving state due to revolutionary inventions or discoveries, if

they apply the straight-line method, may very well reverse the ordinary course, and resolve their doubts, in the early years of use of plant units, in favor of a shorter rather than a longer life.

### IN CONCLUSION

Within the lifetime of our older accountants; the depreciation charge has been successively characterized as improper, then legitimate, and lastly as necessary. There are but few now who contend that the deprecia-

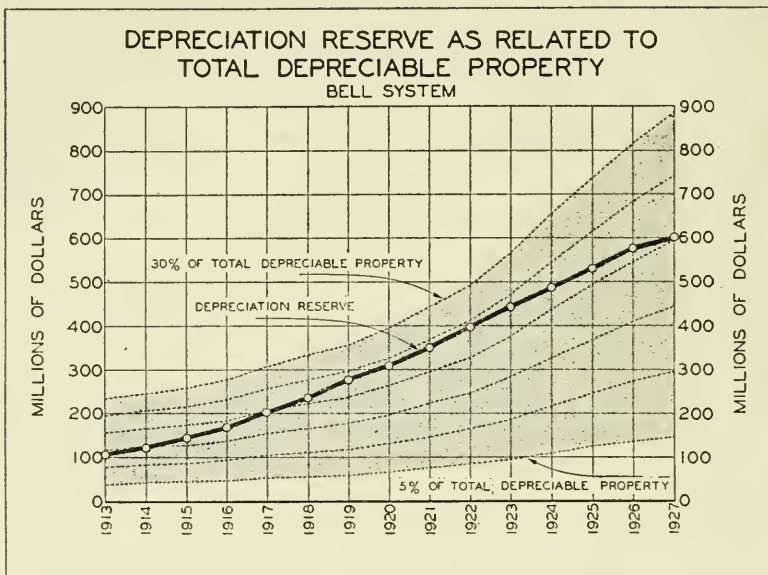


FIG. 17

tion charge is improper; its legitimacy is generally recognized. Not all agree that it should be compulsory. As regards telephone companies, the straight-line basis is generally believed to be in the best interest of the companies as regulated undertakings, and of the public which they serve, and it is compulsory by law.

It is unwise to become dogmatic regarding the treatment of depreciation because the question presents so many different aspects as viewed from different industries, with their varied histories and traditions, prac-



tices, and prospects. Any accounting method which generally commends itself as a fair method to those interested in an industry of a particular type is worthy of a fair hearing and if it has worked well, it should not be lightly overturned. Nevertheless, there cannot be more than one set of sound accounting principles. This makes necessary mutual agreement upon the fundamentals, upon definitions and the use of terms, without which arguments become confused and the meeting of minds impossible. When the terms employed are made susceptible of but one meaning, it may be possible to secure general agreement as to principles, and the application of sound principles to highly various industrial fields of operations may well result in a variety of treatments which are salutary and practicable in certain fields to which suited, but impracticable or inadvisable elsewhere.

In the telephone business in the United States, the suitability of the straight-line depreciation accounting practice has been tested and demonstrated by long experience.

ALLAN B. CRUNDEN,  
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*Editor's Note:* Mr. Crunden is Assistant Comptroller and Mr. Belcher is Assistant Chief Statistician of the American Telephone and Telegraph Company.

## Installation of New Types of Buried Toll Cable

*Abstracted in part from a paper presented at the Bell System Engineering Conference, June, 1929, by C. W. Mier and B. D. Hull of the Southwestern Bell Telephone Company*

THE toll lines of the Bell System consist of two general types, open wire and cable, depending largely upon the number of circuits required along a given route and the rate of growth. When cable has been employed it has been installed either on a pole line or in conduit, the conduit usually being placed under or closely parallel to highways, inasmuch as accessibility to such large units of plant is important from the standpoints of construction and maintenance. Aerial cables are, however, frequently installed along private rights-of-way and this, of course, results in shortening the route.

The recent rapid growth in toll traffic has required the installation of cables throughout constantly widening areas, where a few years ago the traffic was adequately handled over open wire lines. On many of the routes in these areas, conduit could not be justified so that cable on pole lines would normally have been employed. Realizing, however, that there would be advantages in underground installations, considerable study was devoted to the problem of finding a cheaper method of placing cables underground, that would be applicable to these routes. This problem has been solved by the introduction of two methods of installation that are new to the Bell System.

One of these methods employs a cable buried in the ground, without conduit. The lead covered cable used for such installations is manufactured with protective coverings of impregnated paper, jute and steel tape,

which safeguard the sheath of the cable from subsequent soil corrosion and from mechanical damage. The other method, which conforms more nearly to established practices, consists in laying a single fiber conduit and pulling the usual type of lead-covered cable into it by means of the power winch line. In both cases, manholes are constructed at loading points only, and thus about 90 per cent of the manholes employed in the more usual conduit structure are omitted.

Inasmuch as these types of installation are new, it was necessary to develop entirely new procedures for the construction work and in this connection a very important element has been the extensive use of labor-saving machinery, making it possible to carry out the work expeditiously and at relatively low costs. Much of this machinery has been developed for this specific purpose by Bell System engineers and in other cases it was necessary to adapt commercial machinery to meet the requirements of this work.

#### SURVEY AND CLEARING RIGHT-OF-WAY

In general, buried toll cable is located on private property which usually permits the selection of the shortest possible route.

In some cases it has been found desirable to make aeroplane photographs to assist in selecting the route along which the preliminary survey will be made. Such pictures assist materially, particularly through areas where the terrain is broken and wooded, inasmuch as in such locations the selection of a satisfactory route would otherwise be extremely difficult.

After the route has been selected and surveyed, it is necessary to clear it of trees and other obstructions sufficiently to permit the movement of construction machinery incident to digging the trench, delivering and placing the cable and loading coil cases, and backfilling. Clearing the right-of-way is done by means of caterpillar tractors, scrapers, power graders, and in some

cases it is necessary to also employ compressed air equipment.

#### SHIPPING THE CABLE

Both the tape armored cable and the cable to be installed in fiber conduit are shipped in lengths of about 755 feet. For the tape armored cable which in the size now being installed is about 60 per cent heavier than the ordinary lead-covered cable, a steel reel is used. This reel, with its load of cable, weighs about 5 tons. Shipments from the factory are made by either boat or rail or a combination of both, depending upon the point of destination.

It will be noted that sufficient room is left at the end of the loaded car to permit turning the reels in case it is necessary to unload them from the side of the car.

#### DELIVERING CABLE FROM RAILROAD CARS

Wherever practicable the reels of cable are unloaded by rolling them out over the end of the car to the platform of a truck.

However, conditions are met where it is necessary to unload the cable from the car to the ground, in order to store it until the truck deliveries can be made.

For this condition it is usually necessary to locate the power winch equipped truck on the same side of the track as that upon which the reels are to be lowered. The power winch line is threaded under the car, through a special tackle and over the platform of the car to a yoke which lowers the reel over heavy skids to the ground.

#### DELIVERING REELS OF CABLE TO THE JOB

Two methods are in use for delivering cable to locations on private property. The more recent and faster method is to employ a heavy-duty four-wheel-drive truck equipped with a 100 horse-power engine.



Dual pneumatic tires of the largest size now commercially available are used on the rear wheels of this truck. On the front wheels dual tires are also used, the inside tires being of the same size as those on the rear wheels and the outside tires of somewhat smaller diameter and width. This arrangement of tires on the front wheels permits of easy steering on hard surfaced roads and the smaller outside tires come into action immediately when soft ground is encountered. Trucks of this kind have performed satisfactorily both in mountainous territory and where very muddy or sandy conditions had to be negotiated.

The other method of delivering cable to private property consists in moving it as far as practicable with rear wheel drive truck equipment, and then taking it across the private property on trailers equipped with caterpillar tracks and drawn by caterpillar tractors.

Both the four-wheel-drive truck and caterpillar tractor-trailer methods of cable delivery are satisfactory. However, the truck has the advantage of being able to travel at a speed of about 20 miles per hour whereas the tractors make a speed of only four miles per hour.

#### DIGGING THE TRENCH

In ordinary soil a trenching machine of the type illustrated can be operated satisfactorily.

A machine of this type will dig a trench about 15 inches wide and 30 inches deep, such as is required, at the rate of from one-half to one mile per day, depending upon the conditions encountered. It will not, of course, dig through solid rock. However, some soil formations have been excavated, which contained a great deal of rock.

Where much rock is encountered a very ragged trench results. However, the saving due to the use of machinery as compared with hand labor, under such conditions, is very great.

Where the rock contains numerous seams and

weather checks, it is possible in some cases to cut a trench through it by means of a tractor plow. This outfit can also be used in loam or sand but will not dig nearly so deep as the trenching machine. The plow cuts a furrow and partially clears it, the final clearing of the trench being accomplished by means of manual digging.

Where the rock is too hard or too solid for the trenching machine or tractor plow, compressed air equipment is used.

The air compressors for this class of work are mounted on trucks in order to give them maximum portability. The largest tires which can be applied to the truck are used, so that it will negotiate as much of the private right-of-way as possible, with its own motive power. Where this is not possible, it is towed behind a tractor.

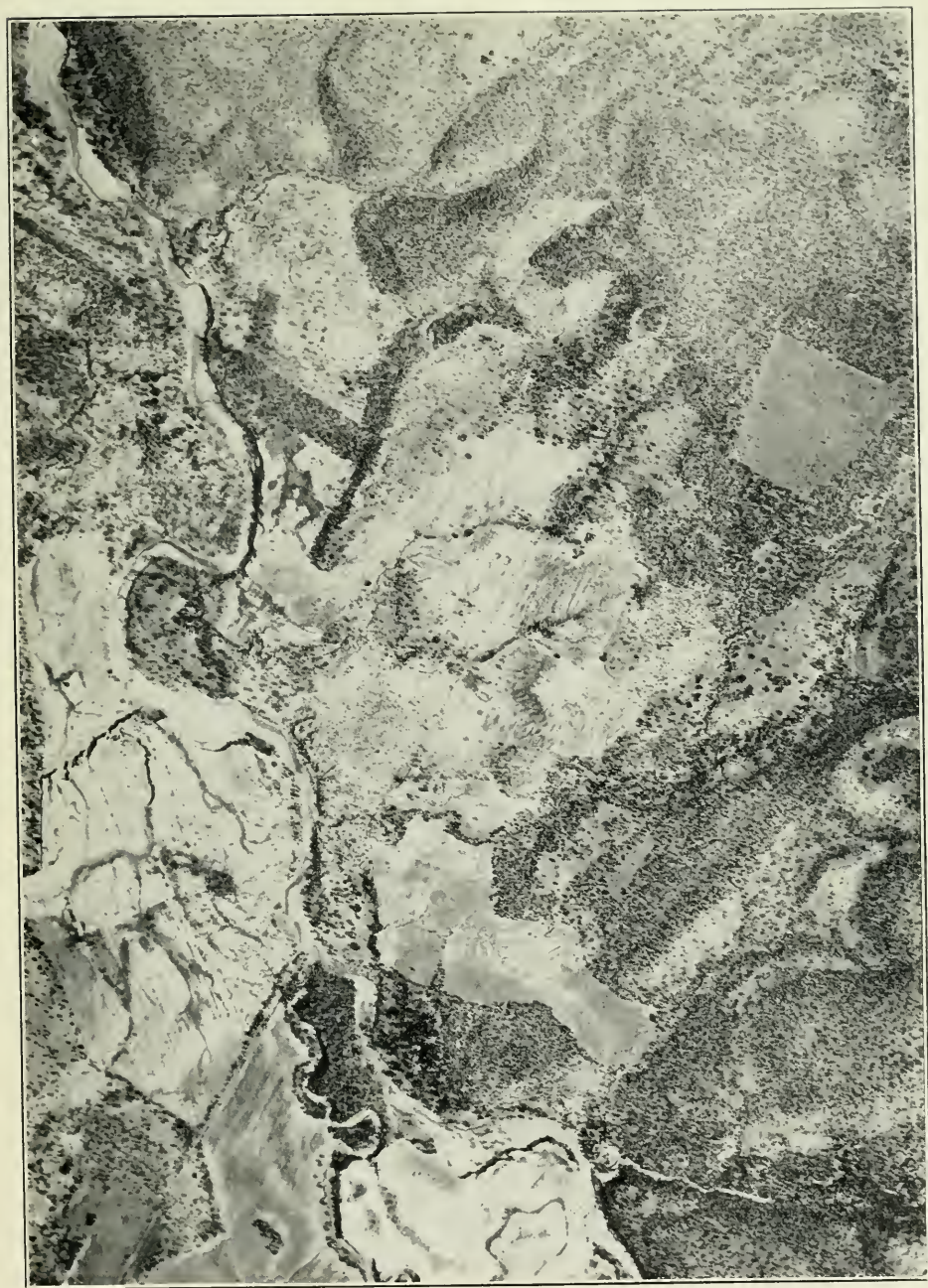
#### LAYING TAPE-ARMORED CABLE

The method most generally used thus far, for laying the tape-armored cable in the trench, has been to feed it off the rear of a caterpillar type trailer. The tractor and trailer, due to their long broad tracks, can operate astride the open trench, lay off the cable from the reel while running along at a speed of about 3 miles per hour and again cross over carrying the empty reel, without injury to the trench or machinery, except in very soft or sandy soil.

Where the traveling conditions permit, two reels are delivered per trip. The cable is first fed off the rear trailer, then from the front one by leading it over the empty reel at the rear.

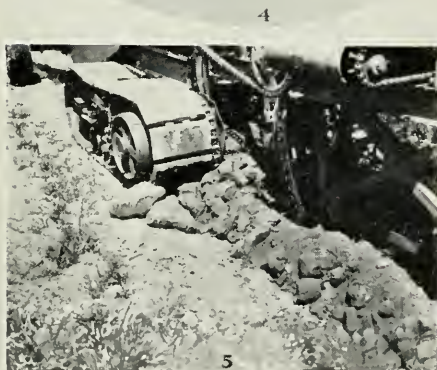
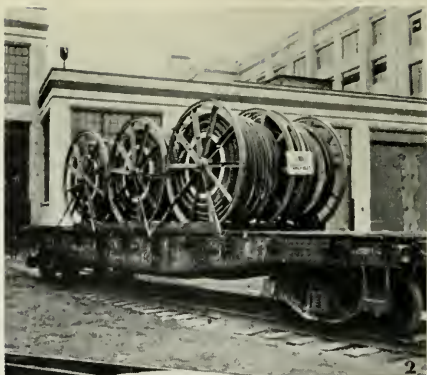
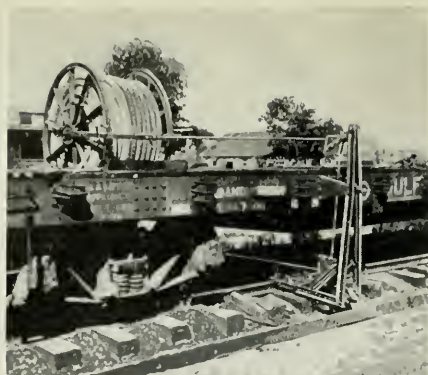
Locations are encountered along the trench where it is not possible to lay the cable direct from the reel. For such locations trench rollers are used and the cable is pulled into the trench over these rollers by means of a power winch line.

By using the trench rollers, the cable can be pulled



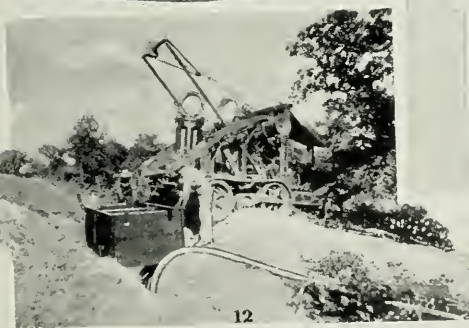
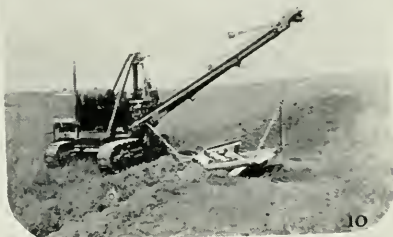
AEROPLANE PHOTOGRAPH OF PROPOSED ROUTE



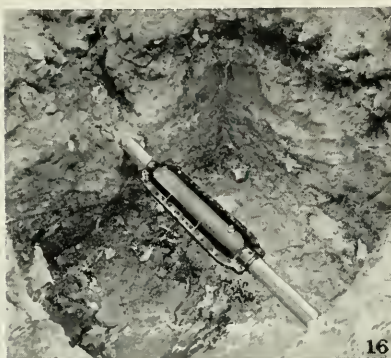


1. RAILROAD CAR UNLOADING TACKLE.
2. CARLOAD OF TAPE ARMORED CABLE READY TO LEAVE KEARNY PLANT OF WESTERN ELECTRIC CO.
3. TRANSFERRING CABLE REELS FROM RAILROAD CAR TO TRUCK.
4. FOUR-WHEEL DRIVE CABLE DELIVERY TRUCK.
5. TRENCHING SOIL WHICH IS FULL OF FLINT ROCK.
6. TRENCHING MACHINE.





7. EXCAVATING WITH COMPRESSED AIR.
8. MECHANICAL TAMPER.
9. SCRAPER TYPE BACK FILLER.
10. DRAG LINE BACK FILLER.
11. TRACTOR PLOW OUTFIT.
12. LOWERING WOODEN MANHOLE INTO EXCAVATION.
13. LOWERING LOADING COIL CASE INTO MANHOLE.



14. DOUBLE TRAILER OUTFIT.
15. TRENCH ROLLERS.
16. SPLICE CASE FOR TAPE ARMORED CABLE.
17. LAYING CABLE FROM CATERPILLAR TRAILER.
18. ARRANGEMENT OF CABLE IN LOADING MANHOLE.
19. SPLICE COVERING FOR CABLE IN FIBER CONDUIT.
20. CONCRETE POST MARKING THE LOCATION OF BURIED CABLE.

under crossing pipe lines, highway pavements, railroads, etc. The trench rollers are also used where soft or sandy soil is encountered which would not support the tractor and trailer over the trench.

#### BACK-FILLING

Where the excavated soil is on one side of the trench as in trenching machine operation, the drag line type of back-filler is applicable. This machine rapidly pulls the dirt into the trench, a scoop full at a time, as it moves along the side opposite the spoil pile.

A trench made by the plow has, of course, two small spoil piles, one on each side of the trench. For this condition a back-filler of the scraper type is used.

#### TAMPING

Where a trench is located along a highway, it is ordinarily necessary to tamp the back-filled earth. On private property, the usual practice is to pile a ridge of dirt over the filled trench, then leave it for the rain to settle. However, if tamping is required, the same types of machines are applicable as for the highway work.

Very few obstructions such as pipes crossing the trench are encountered in buried cable installations, due to the fact that they are not made in thickly settled areas. The mechanical type of tamper is best adapted to this kind of work because of its greater speed. However, an equally good, although somewhat slower job of tamping can be done with compressed air tools which are better suited for tamping around pipes or other obstructions.

#### SPLICES IN BURIED CABLES

At the locations of splices between consecutive lengths of cable, other than at loading points, manholes are not used. The trench is widened and deepened to provide working space for the splicers and testers.

It is, of course, necessary to remove the tape armor and jute servings from the ends of tape armored cable,



before splicing it. The splice is then made in the usual manner, and subsequently, a cast iron splice case, made in two halves, is bolted over the splice. Each end of the case extends over the tape armor. This case which is filled with a waterproof compound, protects the splice against mechanical damage.

In the case of the cable in fiber conduit, an opening is left between the consecutive lengths of conduit at the splice points, and the splice made between these lengths. Upon completion of the splice a fiber sleeve is slipped over it, overlapping the ends of the fiber conduit. Ring wedges, also made of fiber, are driven in at the ends of the fiber sleeve and serve to hold it in place as well as to prevent the entrance of soil and water.

#### PRESSURE TESTING

An interesting innovation in the case of the tape armored cable consists in having the cable shipped from the factory with gas pressure in each length. The ends of the length of cable are equipped with valves that permit the pressure to be read, by means of a portable gauge, this being done before the cable is laid and the trench back-filled. Upon completion of the splicing, gas pressure tests are applied in the usual manner to both types of cable to ensure the integrity of the sheath and wiped joints.

#### LOADING MANHOLES

The manholes at loading points are installed at such a depth that the roof is about two feet below the surface of the ground. No manhole opening is used, the soil being replaced over the roof so as to permit agricultural operations to be carried on. The roof of the manhole is made in sections which can be lifted off when occasion requires the manhole to be entered subsequent to the initial installation and thus provide space in which to work. It will, of course, be necessary to excavate the soil from above the manhole to enter it, but it is ex-



pected that necessity for this will arise only infrequently. No floors are used, the loading coil cases being buried in the earth bottoms of the manholes.

Since many of the manholes are located in private property where they will not be required to support the heavy loads imposed upon manholes located under highways, they are sometimes built of creosoted wood planks. In such cases the manhole is assembled above ground at the point where it is to be used and lowered into the excavation by means of a power derrick.

The special derrick equipment used for lowering the wooden manholes is also employed in handling the heavy loading coil cases subsequently installed in the manholes. The derrick is so arranged that it can be lifted to any desired position and the loading pot raised or lowered independently. The motor vehicle shown handling the manhole and loading coil cases is equipped with removable tracks which can be placed around the wheels when it is desired to negotiate soft ground.

As will be noted in the illustration, the first loading coil case is installed in a corner of the manhole and later a second case will be placed in the corner at the opposite end, where the stub cable can be brought into the main cable in a second splice.

### MARKERS

While the cable generally traverses private property where there would be little likelihood of its being disturbed and damaged by subsequent excavations, this is not always true where it crosses highways. Consequently, at such points the cable is laid at a depth of about four feet, and at each side of the road a concrete post is set to indicate the location of the cable. A sign mounted on each post so placed, warns persons who might be engaged in excavating activities along the road not to disturb the cable. Similar posts are set at property lines intersecting the route of the cable and at other points so as to assist the maintenance forces in locating

the cable. Each of these posts carries a copper plate on which is inscribed the serial number of the post, thus affording association with the post locations on the map record, and also other pertinent information, such as the distance from the post to the cable.

In a short article such as this it is, of course, impossible to cover the many details which must necessarily be worked out by the engineering and construction forces. These types of installation are now just getting under way, and while there has been only a comparatively small amount of buried cable placed up to the present time, plans are now being made for a number of additional installations. As more experience is gained with this type of construction, new developments and refinements will doubtless be made in the heavy handling machinery and in the methods. However, due to the general interest in buried cable, this short review is given to indicate what is being done at the present time.

# Long Distance Telephony in Europe

## FOREWORD

WITH the opening of transatlantic telephone service, international long distance telephony took on a new aspect. The provision of a telephone link between the Old World and the New might be considered the opening phase of intercontinental and world wide telephony. In the following article, Dr. King describes progress made in the extension and improvement of the long distance telephone service in the Old World and the important co-ordinating influence of the International Consulting Committee for Long Distance Telephony in Europe known as the C. C. I. Since the opening of transatlantic telephone service between England and the United States in 1927, additional channels of communication have been added and telephone users in the United States now have telephone access to most of the important countries of Europe as well as to Cuba, Mexico and Canada. The development of international telephony on a world-wide basis requires that we of the Bell System have an understanding of and a friendly interest in the telephone problems of other nations, and as one means to this end, the American Telephone and Telegraph Company is associating itself with the work of the C. C. I. The organization and functions of the C. C. I. will be explained in a subsequent article. The author, Dr. R. W. King is a member of the staff of the technical representatives in London of the American Telephone and Telegraph Company. THE EDITOR.

## LONG DISTANCE TELEPHONY IN EUROPE

We in the United States have always stressed the importance of nation-wide telephone service and are now proud of the fact that the present scope of our communication system is not even limited by our national boundaries but embraces the greater part of the

telephone-using World. The opening of transatlantic service in January, 1927, marked a new epoch in telephonic progress. The calls that pass to and fro over the three transatlantic circuits average upward of 1200 per month—a ten-fold increase in traffic since the initiation of this service—and naturally constitute a very

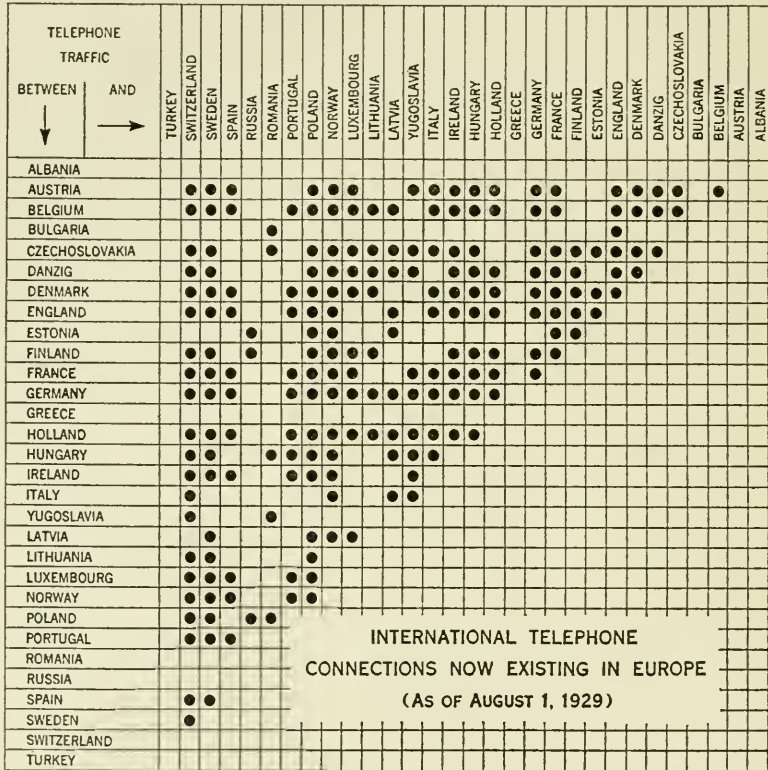


FIGURE 1

substantial basis for American interest in European telephony.

A complete description of long distance telephony in Europe would be far beyond the scope of a single article, and of the various angles from which it might be treated, an introductory discussion may well be limited to a consideration of the inherent difficulties that



have opposed long distance telephone development on the eastern side of the Atlantic, and the extent to which these have been overcome.

#### LONG DISTANCE CALLS IN EUROPE

Considering the peculiar difficulties that have had to be overcome, the developments of the last four or five years in long distance telephony between the leading nations of Europe are remarkable. The network of international connections now embraces all of western Europe, as is indicated in the accompanying chart, Fig. 1, and the nations of eastern Europe are rapidly being connected in.

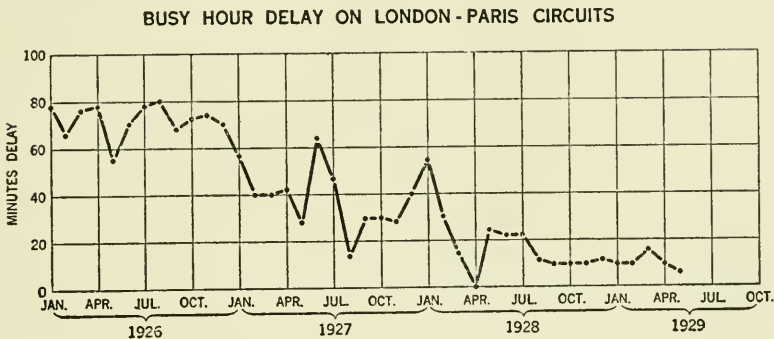


FIGURE 2

Nor do these connections represent only single lines or small groups of lines so burdened with traffic as to make exasperating delays the common rule. It is well recognized in Europe that speed of service and a reasonable rate stand equally in importance with good wire connections. In all of these respects most creditable progress is being made. Delays have been everywhere reduced during the last three or four years; on most of the main international routes cuts range from a reduction of from one-half to one-fifth of the time previously required, and even more. On the London-Paris circuits (of which there are twenty-two now) the average

busy-hour delay has been reduced from an average of seventy minutes in 1926 to twelve minutes for the first half of 1929. During this same period traffic has risen from about 1000 calls a day to about 1600, an increase of over 50 percent. The month-to-month variations of delay are shown in detail in Fig. 2.

On the long routes, say, over 500 miles, which were available three or four years ago, delays of one and a half or two hours on calls booked in the morning were an everyday occurrence. Delays of this character are now quite exceptional.

The progress that the telephone has made in Europe within the last few years is remarkable when considered by itself, but it becomes much more remarkable when we bear in mind the imposing phalanx of difficulties which its advancement has had to meet.

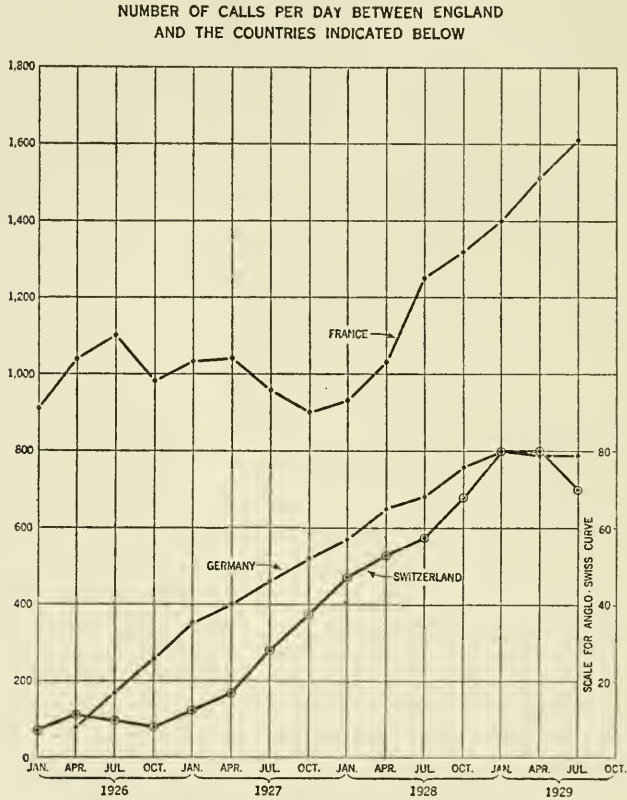
The opening of our first transcontinental line dates from 1915. This event marked the commercial advent of the repeater employing high-vacuum thermionic tubes. In the United States this repeater was at once adopted into the telephone plant and everyone is now familiar with the wholly new aspect it, together with many other improvements, has given to long distance telephony. In Europe, however, the War was then in progress and not for another five years at least had international relations approached sufficiently near normal that the building and operation of new international telephone lines could be contemplated. Long distance telephony as we understand it in terms of the present technique dates therefore in Europe from about 1920 and its span of life has been a scant two-thirds of that it has enjoyed in the United States. As a matter of fact, there were until as late as 1925 very few international agreements regarding the building of telephone lines across national boundaries and the exchange of telephone traffic. However, those who have acted in Europe as advisers and directors for the telephone have worked so effectively that the service is fast approaching the most up-to-date standards.

European telephony is today a splendid example of friendly international co-operation. Each nation builds and maintains all lines within its boundaries whether these are used for internal or for through ("transit") calls. Not only the question of the number of through circuits which any nation supplies to neighbouring nations is subject in the last analysis to its own decision without interference from without, but this is equally true of the myriad electrical factors or properties of each of its telephone lines. Were each nation to take a purely selfish view, determining these factors on a nationalistic basis and without regard to the telephone networks in nearby countries, the physical, and therefore the fundamental, basis of long distance telephony would vanish, and any attempts at international communication by word of mouth would be largely frustrated. A remarkable spirit of give-and-take has prevailed and thanks to certain unifying influences, the more important of which will be discussed presently, Europe now possesses a notable international telephone plant. Today one can ask for a connection from London to Paris, Geneva, Berlin or Stockholm—merely to mention typical cases, with assurance of having a circuit of very satisfactory clearness placed at his disposal.

As typical of the growth of international traffic, Figure 3 shows the trend of calls between England and France, England and Germany, and England and Switzerland.

Some of the most important long distance lines in Europe cross intermediate countries and their construction and operation require an international point of view and noteworthy international co-operation. Thus, lines between England and Germany must cross either Belgium or Holland and the portion of each circuit lying within the boundaries of the transit country is built and maintained by that country. The Telephone Administration of the transit country is the final arbiter as to the number of through lines it will provide

and the rates it will charge for their use. Transit countries, therefore, play a very fundamental part in determining the quality of international service and good service requires that each such country provide an adequate number of lines for other countries' traffic on acceptable terms.



It may be said in regard to provision of plant, as distinct from questions of operation and rates that most transit countries have adopted a far-sighted policy, and have laid expensive cables freely, to provide for considerable growth of traffic passing through their territory. Indeed, the development of European international traffic witnessed during the past few years has



been in no small measure due to such international-mindedness.

#### ADJUSTMENTS RATE

The question of rates on international calls also presents many complexities. On the one hand, transit countries might naturally be expected to measure the satisfactoriness of a rate largely in terms of the return it nets them on their investment. Terminal countries, on the other hand, while naturally having the same interest in the return, also associate with rates the question of whether or not they are giving satisfaction to their citizens who use the service. At the same time, the transit country is likely to consider, and with some misgiving, that a rate quite satisfactory from the user's point of view will in a short time create a demand for more through circuits and therefore for an increased capital investment on its own part. With finances on a normal footing no embarrassment would accrue from such growing demands, but because of post-war stringencies most of the nations of Europe have had to consider capital outlays very carefully. Such problems as these are, however, rapidly yielding to solution, and the experts who are struggling with them are of course greatly aided by the fact that the telephone business, wherever wisely administered, has always proved quite able to pay its own way.

The question of international rates also brings into consideration the varying cost indices between nations. As closely associated as they are, the various countries of Europe differ considerably in the matter of cost levels. A rate satisfactory to a country of low costs would obviously not ensure an adequate return on equivalent telephone plant in a country of high costs. Here again, however, a working agreement has been arrived at, and under its influence, together with that of a steadily increasing supply of modern circuits, international traffic is growing by leaps and bounds.

THE PROBLEM OF LANGUAGE

Another ever-present difficulty concerning long distance telephony in Europe is that of languages. This manifests itself in two distinct ways. One is the hindrance it interposes to those who would like to use the international telephone; the other is presented in the operation of international circuits. The language difficulty is not so great in the case of neighbouring nations such as France and England or Germany and Denmark, because in advance of the telephone, immediate geographical proximity had already spread some knowledge of each country's spoken language over the boundary into its neighbour's territory, but it becomes of no inconsiderable magnitude in the case of calls between widely separated countries, as between Sweden and Spain, or Poland and Italy, or England and Czechoslovakia. In the case of such countries, the citizens engaged in international business are for the most part quite unfamiliar with each other's speech and usually conduct their international business by mail or telegraph with the aid of foreign correspondence clerks, i.e. translators with special linguistic training. Considering that in such cases the general use of the telephone involves new mental equipment and a new business technique, the comparative rapidity of its growth is remarkable.

From the operating point of view also, the language separation involves special difficulties which are, in fact, far more serious than those arising from separation in space. These difficulties are minimized where through circuits between the terminal countries are available, and this we might say is the normal method of providing international telephone connections. Even so, to take specific cases, it is not very practicable to provide operators in England who can speak Spanish and Italian, and in Madrid and Rome who can speak English. In general too many languages would be involved; or to put it another way, the number of through

## *Long Distance Telephony in Europe*

circuits now in existence between each pair of countries is not large enough to warrant the maintenance of groups of reserve and emergency operators, one group for each pair of languages. In the cases cited of Anglo-Spanish and Anglo-Italian circuits this difficulty is overcome by the use of French for operating, because groups of French-speaking operators are, in any case, required to work the circuits to the intermediate French-speaking countries. Similarly in the case of

TELEPHONE TRAFFIC BETWEEN ENGLAND AND HUNGARY

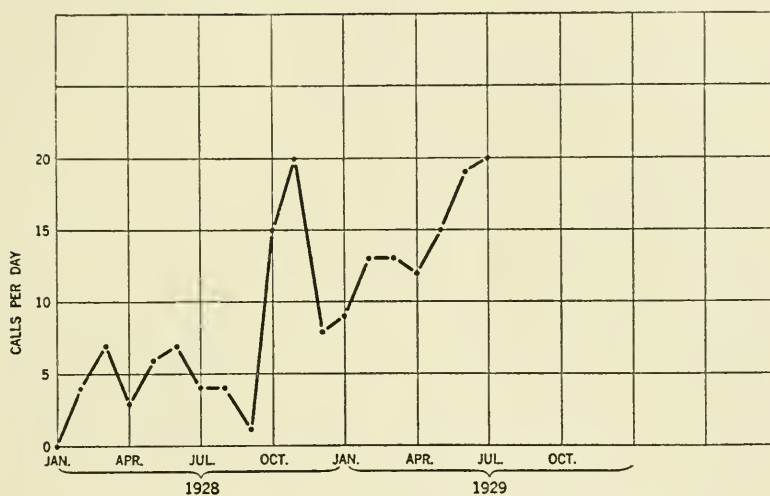


FIGURE 4

other groups of through lines, a suitable common language is employed.

In most cases where a circuit has to be built up specially for a long distance international call, the language difficulty is much aggravated. In these circumstances built-up circuits are only used in European international service in the early stages of traffic development or for the routing of emergency calls in the case of break-downs. "Through" circuits are permanently put in service between selected cities in the terminal countries as soon as the traffic is sufficient to

fill even one circuit. Transit traffic and the number of long through circuits required to handle it are rising with the general tide, as witness the record of traffic between England and Hungary as shown in Figure 4.

#### TELEPHONE SYSTEMS IN UNITED STATES AND EUROPE— A CONTRAST

The preceding paragraphs do not propose to be a complete catalog of the peculiar and unique difficulties which long distance telephony has had to face in Europe, but the points enumerated will serve to show the great need that Europe has had of some central guiding and unifying influence. Europe has possessed none of the centralized departments which we prize in the Bell System, such as a central laboratory for development, a headquarters engineering staff to study and advise on field conditions and to standardize design, a centralized control of patents, making them equally available to all operating units and finally and equally important, machinery for establishing standard operating practices. It can truthfully be said that the successful working out of long distance telephony in the United States has supplied an ever-present illustration of what international telephony in Europe might attain to, and without our success overseas to point to, the path of its advocates would have been much rockier.

However, Europe could not have achieved its rapid progress in international telephony without some very definite guiding and unifying influence. Naturally, the need of some permanent international machinery to direct the progress of international telephony has long been recognized, and doubtless would have sprung into existence years before it did had it not been for the War. Indeed, there have existed for many years such illustrative organizations as the Universal Postal Union and the International Telegraph Union, with their permanent secretariats and periodic congresses.

As has already been pointed out, international tele-



phony presents many unique difficulties. No special precision of adjustment is required for the transfer of mail, freight and passengers across national boundaries, and even the problem of international telegraphy is simple compared with that of telephony. The electric circuit which transmits a telephone message must operate as a single unit from end to end. Transmission standards as expressed by the various European nations in transmitter and receiver efficiency, in the behaviour of repeaters, in the design and spacing of loading coils, and in countless other respects, have had to be adjusted to a basis of practical equality.

In large measure the influence guiding telephony in Europe has been supplied by a voluntary organization, made up of representatives from each of the national telephone administrations. This Association, known as the International Consultative Committee for Long Distance Telephony in Europe—or C. C. I. for short—came into existence in 1924 as the outgrowth of an informal advisory committee which originated about one year earlier. It has been said that the initial meeting of the C. C. I. was perhaps the first occasion after the War when official representatives of the formerly combatant powers, other than soldiers and diplomats, met around the conference table. Whether this is true or not, it can safely be said that the meetings and conferences of the C. C. I. represent as fine an international spirit as has been manifested by any gathering of representatives of the Powers; and to this, one can scarcely refrain from adding that, by labouring on behalf of international telephone service, they have conspicuously advanced the basis of understanding between nations and the cause of permanent peace. We in the United States have always considered the telephone as an outstanding instrument of service, and it is gratifying to see it now so established in Europe that it is beginning to prove its power in this respect.

R. W. KING.

## 1929 Convertible Bond Offer of the American Telephone and Telegraph Company

THE American Telephone and Telegraph Company offered to its 455,000 stockholders of record on May 10, 1929, \$219,112,700 of Ten-Year Convertible 4½% Gold Debenture Bonds due July 1, 1939, in the proportion of \$100 principal amount of bonds for each six shares then held. The bonds were offered for subscription at face value and payment in full was due July 1, 1929. The offer was not underwritten.

The principal amount of the issue, \$219,112,700, represents the largest financing ever undertaken by the Bell System, and is believed to be the largest ever offered to stockholders for subscription by any corporation; the 1928 stock offer of the American Company amounting to about \$185,000,000 doubtless having previously held the record. If all of the bonds should be converted into stock at \$180 per share during 1930 under Option (a), the Company would receive an additional \$175,000,000 or a grand total of nearly \$400,000,000.

The purpose of the offering was to provide funds for the payment of approximately \$75,000,000 Collateral Trust Four Per Cent. Bonds of the Company maturing July 1, 1929, and for new construction which is required by the Bell System to care for additional business resulting from the continuously increasing use of telephone service. In the current year more than \$550,000,000 will be spent on plant additions, betterments and replacements. This is the largest program in the history of the Bell System and similar large expenditures are planned for the years to follow.

#### TERMS OF THE ISSUE

The bonds are convertible into stock of the Company during the period January 1, 1930 to December 31, 1937 at the conversion price of not more than \$180 per share for the year 1930, \$190 per share for the years 1931 and 1932 and \$200 per share for the remainder of the period, provided, however, that bonds called for redemption on any date within the conversion period may be surrendered for stock not later than their redemption date. The conversion prices are subject to reduction upon the issue from time to time of additional stock by the Company in accordance with the terms of the indenture. In converting, the bondholder may take (a) one share of stock for each \$100 principal amount of bonds surrendered, on payment in cash of the difference between the conversion price then in effect and \$100, or (b) he may take as many shares of stock as the principal amount of bonds surrendered is a multiple of the conversion price then in effect, and if there is a remainder the bondholder may take one additional share on payment in cash of the difference between the current conversion price and such remainder. When the bonds are selling at a market price above their principal amount it will usually be advantageous to the bondholder to convert under Option (a).

#### RESULTS OF THE ISSUE

In recent months, the general investing public has shown a slackened interest in bonds except those with stock privilege features. Convertible bonds have proven quite attractive however, and this fact contributed to the marked success of the convertible bond offering of the American Company. A total of 165,000 subscriptions was received, exceeding that for any previous Bell System bond issue. In addition there were many subscriptions filed by banks and brokers for individual investors which cannot be identified as such

and are accordingly excluded from the count. Only one-half of one percent of the rights was allowed to lapse. These are satisfactory results, especially when it is considered that of the 455,000 stockholders entitled to subscribe, relatively few had had previous experience with convertible bond offers.

Due to the changing conditions in the securities market, which had their effect on American Telephone stock and thus on the rights, the price of the latter exhibited rather marked variations during the subscription period. The day of the announcement of the issue, April 30, rights sold as high as \$7 $\frac{7}{8}$ . During May the general price trend was downward and a low of \$3 was reached on several days at the end of the month. June witnessed a reversal in trend, the price rising to a high of \$8 on June 29, with a final price on the New York Stock Exchange of \$7 $\frac{7}{8}$ .

As has always been the case when the American Company offers securities to stockholders, the bulk of the subscription payments is received at the very end of the period. Banks and brokers especially, making payment for their own and for their clients' accounts, observe this practice in order to save interest. Of a total of \$218,000,000 received, only \$35,000,000 had reached the Company and been deposited by June 27, four days before the expiration date. On July 1 alone, over \$106,000,000 was received and deposited.

To add to that day's volume of business the Treasurer's Office issued checks for \$60,000,000 in payment of Collateral Trust Four Per Cent. Bonds maturing then and presented on or before July 1 and also \$2,730,000 in payment of bond coupons due July 1. That part of the proceeds of the convertible bonds not required for immediate use was invested in short term securities of unquestionable safety, principally government and municipal obligations.

A résumé of the results of the bond issue is set forth in the following table:



## 1929 Convertible Bond Offer

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TABLE I

STATISTICS ON THE 1929 CONVERTIBLE BOND ISSUE

|                                                             |               |
|-------------------------------------------------------------|---------------|
| Principal amount of bonds offered . . . . .                 | \$219,112,700 |
| Approximate amount of bonds subscribed . . . . .            | \$218,000,000 |
| Percent subscribed . . . . .                                | 99½%          |
| Number of stockholders of record . . . . .                  | 455,160       |
| Approximate number of subscriptions . . . . .               | 165,000       |
| Subscriptions in percent of stockholders . . . . .          | 36%           |
| Average principal amount offered, per stockholder . . . . . | \$481         |
| Average principal amount per subscription . . . . .         | \$1,314       |

### AID GIVEN STOCKHOLDERS

In accordance with the Company's policy of endeavoring to offer special assistance to those of its stockholders who seemed most likely to require it, individually addressed letters were sent on May 22 to 8,000 individuals entitled to subscribe who had failed to exercise their rights to the 1928 stock issue. The communication explained that the 1929 rights had value and that they should either be used in subscription or be sold for cash by July 1. These stockholders had, of course, already been sent the circular of April 30 announcing and giving full details of the terms of the offer and also the circular of the Bell Telephone Securities Company which accompanied the warrants mailed on May 20 to all stockholders. The latter communication included a list of simplified questions and answers about the issue and an order form to facilitate the purchase or sale of rights through the Bell Telephone Securities Company.

As in the case of the 1928 stock issue, the Associated Companies were furnished with the names and addresses of those of the 8,000 stockholders who lived in their territory, and attempts were made to reach these individuals personally before the close of the subscription period. In cases where a telephone communication was insufficient, a fuller explanation was given in a personal interview by a Company representative. These stockholders were, with few exceptions, of limited means and the ones who could least afford to sacrifice the value of their rights.

Through these varied means, the interests of thousands of stockholders were protected, and as had been the previous experience, many of them expressed their appreciation for the assistance received.

#### OTHER ASSISTANCE RENDERED

Over 385,000 stockholders or 85 percent of the total stock list received fractional warrants, some with and some without full warrants, and all of these fractional warrants had to be pieced out in order that they might be utilized in subscription, or which could be sold. In order to facilitate these transactions for the stockholders residing in all parts of the country, the Bell Telephone Securities Company as in the past offered its facilities for the purchase or sale of rights and the filing of subscriptions both at its home office and through most of the business offices of the Associated Companies.

Transactions in rights in the field averaged about  $7\frac{1}{2}$  rights, while subscriptions filed averaged about \$425. An idea of the extent to which these facilities were utilized may be gained by the fact that of a total of 154,000 transactions for the purchase and sale of rights effected through the Securities Company, 103,000 were handled through the field. The latter figure compares with about 76,000 transactions so handled in the field during the 1928 stock issue and represents more than a one-third increase in activity. In addition over 31,000 completed subscription transactions were handled through the Associated Companies. The stockholders in the western states, as was the case last year, were the ones who availed themselves most largely of the facilities offered through the Associated Companies.

The following table gives data on rights purchases and sales and subscriptions filed through the Associated Companies rendering aid during the bond issue.



1



2

1. A VIEW OF THE COMMUNICATIONS BUREAU WITH THE MAIL SECTION AND RIGHTS BUREAU IN THE BACKGROUND.

2. A PORTION OF THE SUBSCRIPTION REVIEWING AND RECORDING SECTIONS WITH THE BOND ISSUE CASH BUREAU IN THE FOREGROUND.





3



4



5

3. A UNIT OF THE BOND DELIVERY SECTION METERING REGISTERED MAIL ENVELOPES PREPARATORY TO MAILING.

4. A SECTION OF THE BOND DELIVERY ORGANIZATION SHOWING EMPLOYEES ENGAGED IN COUNTING BONDS, RECORDING THE ALLOTMENT TO INDIVIDUAL SUBSCRIBERS AND ENCLOSING THE BONDS IN ENVELOPES.

5. A VIEW OF THE MAILING UNIT OF THE BOND DELIVERY ORGANIZATION SHOWING REGISTERED MAIL ENVELOPES BEING PREPARED AND CHECKED PRIOR TO DELIVERY TO THE POST OFFICE.



## 1929 Convertible Bond Offer

TABLE II

1929 BOND ISSUE TRANSACTIONS HANDLED LOCALLY BY ASSOCIATED COMPANIES  
FOR THEIR PATRONS

| Associated Companies                | Purchases and Sales<br>of Rights |                                                                            | Subscriptions<br>Filed         |                                                                            |
|-------------------------------------|----------------------------------|----------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------|
|                                     | Number<br>of Trans-<br>actions   | In Per-<br>cent of<br>Stock-<br>holders<br>Resident<br>in the<br>Territory | Number<br>of Trans-<br>actions | In Per-<br>cent of<br>Stock-<br>holders<br>Resident<br>in the<br>Territory |
| New England Tel. & Tel. Co. . . .   | 3,072                            | 3.0                                                                        | 1,106                          | 1.1                                                                        |
| Southern New England Tel. Co. .     | 800                              | 5.7                                                                        | 165                            | 1.2                                                                        |
| New York Tel. Co. . . . .           | 12,011                           | 14.2                                                                       | 3,629                          | 4.3                                                                        |
| New Jersey Bell Tel. Co. . . . .    | 3,188                            | 12.2                                                                       | 818                            | 3.1                                                                        |
| Bell Tel. Co. of Penn. . . . .      | 11,642                           | 27.3                                                                       | 3,365                          | 7.9                                                                        |
| Chesapeake and Potomac Tel. Co.     | 5,112                            | 27.6                                                                       | 1,366                          | 7.4                                                                        |
| Southern Bell Tel. & Tel. Co. . . . | 4,119                            | 25.3                                                                       | 971                            | 6.0                                                                        |
| Michigan Bell Tel. Co. . . . .      | 3,039                            | 43.9                                                                       | 622                            | 9.0                                                                        |
| Indiana Bell Tel. Co. . . . .       | 960                              | 38.8                                                                       | 135                            | 5.5                                                                        |
| Wisconsin Tel. Co. . . . .          | 4,156                            | 49.9                                                                       | 1,208                          | 14.5                                                                       |
| Illinois Bell Tel. Co. . . . .      | 15,234                           | 34.9                                                                       | 4,607                          | 10.6                                                                       |
| Northwestern Bell Tel. Co. . . . .  | 5,891                            | 49.3                                                                       | 1,566                          | 13.1                                                                       |
| Southwestern Bell Tel. Co. . . . .  | 11,892                           | 55.8                                                                       | 3,363                          | 15.8                                                                       |
| Mountain States Tel. & Tel. Co. .   | 4,290                            | 45.6                                                                       | 1,358                          | 14.4                                                                       |
| Pacific Tel. & Tel. Co. . . . .     | 17,541                           | 48.6                                                                       | 7,491                          | 20.8                                                                       |
| Total . . . . .                     | 102,947                          | 23.1                                                                       | 31,770                         | 7.1                                                                        |

Thus in all parts of the country the Bell System facilities aided stockholders, and especially small stockholders, in handling their rights. In addition through the New York and Boston offices of the American Company, the Securities Company handled a total of 51,000 transactions in rights as against 45,000 of such transactions in 1928, the majority of these being handled by mail. These transactions averaged in size  $8\frac{1}{3}$  rights.

### ORGANIZATION AND PERSONNEL

As is the case of stock offers, this convertible bond issue was handled by the Treasury Department. Although its permanent personnel is experienced in conducting stock issues, there were many problems of a different nature to solve, as for example, that of pro-

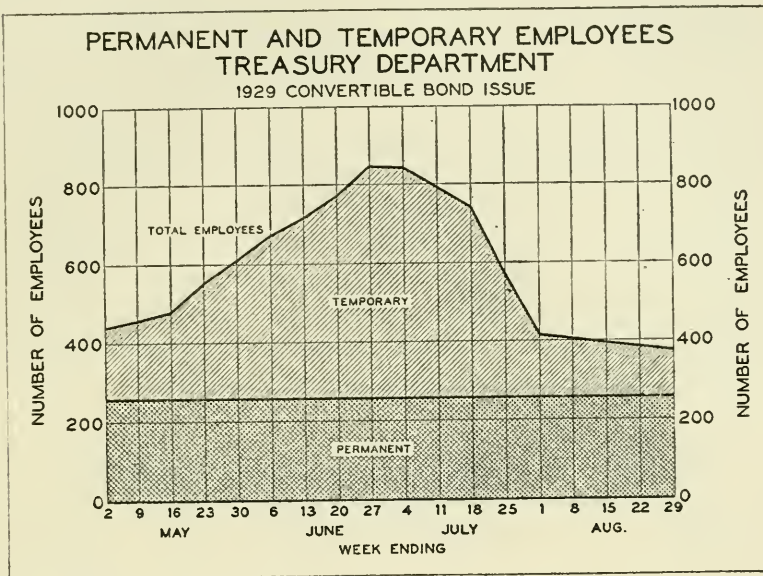
duction in various phases of the work, the estimation of personnel requirements and the handling and delivery of bearer securities. Stock issue methods were used as much as possible, but there were some operations for which no recent precedent existed and which required the development of entirely new practices.

The bonds were issued in the form of temporary bearer certificates with the first two semi-annual interest coupons attached, these temporary bonds being exchangeable on and after October 1, 1930 for the definitive bonds with all subsequent coupons attached. This plan of issuance was decided upon as more practical and economical than that of issuing temporary interim receipts and then, prior to the date of the first interest payment, exchanging them for the engraved bonds with all coupons attached. As it seemed probable in the light of past experience that numbers of bondholders would convert their bonds before October 1, 1930, the number of pieces of the definitive bonds to be produced, authenticated and exchanged should be substantially reduced and the saving to the Company effected by this plan should be of substantial size.

To assist the permanent employees of the Treasury Department in handling the bond issue work, a force of about 600 temporary employees was utilized, this peak being reached, of course, near the close of the subscription period. The number of temporary employees in the 1928 stock issue, however, exceeded this total by about 125.

The quality of the temporary personnel was high. Although the bond issue began during a period when it was not possible to obtain as high a percentage of men from the colleges at the beginning of the issue as was done last year, nevertheless, as time passed and more students, recent graduates, and instructors became free for summer employment, numbers of them were added to the organization. A total of 189 men from 76 colleges and universities were engaged. These

men were of the type which proved very adaptable to their new conditions. In addition, more than a score of permanent employees from other parts of the Bell System filled positions of responsibility.

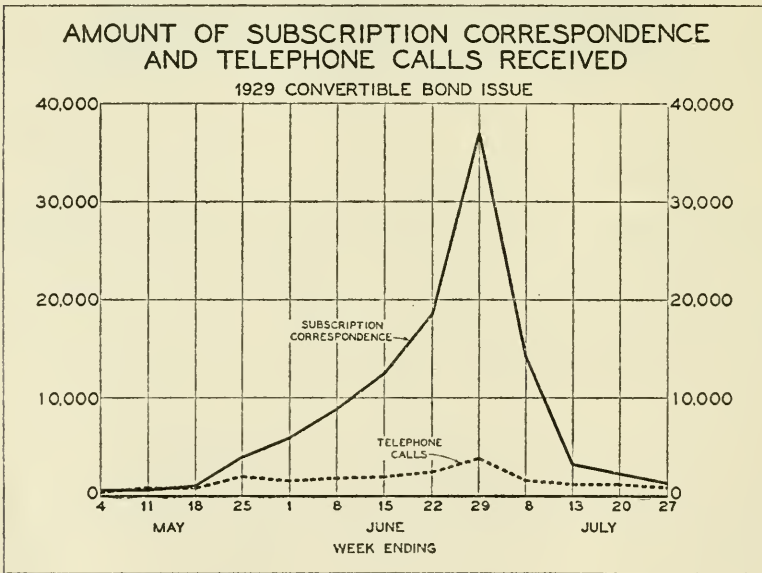


With such an increase in the work and in the personnel of the Treasury Department, available quarters at 195 Broadway were quite inadequate. Consequently, the entire sixth floor of the New York Federal Reserve Bank Building, containing 33,000 square feet of additional office space, was engaged, and 560 employees, the bulk of the bond issue organization, were moved there. While this division in the Treasury Department forces was not an ideal arrangement, automobile messenger service at frequent intervals proved satisfactory in linking the whole organization together. The accompanying illustrations show various sections of the bond issue organization in the process of handling their work.

The data on the volume of mail give one an idea of the size of the undertaking. About a million and a quarter pieces of bond issue mail were sent and received,

and at the same time, of course, the regular Treasury Department correspondence was handled, and the regular July dividend checks to over 455,000 stockholders were prepared for release.

Although the bond issue correspondence was somewhat less in volume than was last year's stock issue correspondence, it was of a more difficult nature to answer, due to the lack of knowledge of large numbers of stockholders concerning this type of financing. The chart below shows the amount of subscription correspondence and telephone calls received by weeks. Of a total of over 100,000 incoming letters, about 35,000, those representing incomplete and irregular subscriptions, were referred to the special organization handling the correspondence work. Of the latter total almost one-half required the preparation of special replies.

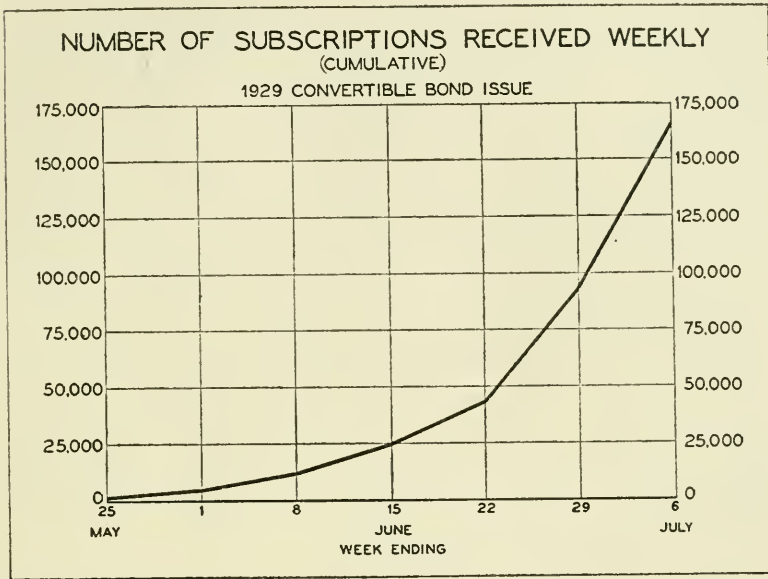


As indicated by the chart on the next page, the subscriptions did not flow in evenly over the entire period but rose to a sharp peak at the close. For example, the



## 1929 Convertible Bond Offer

number of subscriptions received through the middle of June represented less than one-sixth of the ultimate total. The work involved in correspondence and in the rights purchase and sale transactions also, experienced marked peak loads, and on July 1 the operation of delivering the temporary bonds to the subscribers began.



This problem of delivering the bonds was one of the most important confronting the Treasury Department on which no help could be had from past stock issue experience. In order to fill the subscription allotments 307,600 \$100 pieces, 39,700 \$500 pieces, and 167,350 \$1,000 pieces, or a total of 514,650 pieces were required. When it is considered that these bonds are in bearer form, an idea may be gained of the great responsibility placed upon each employee engaged in bond delivery work. It is a credit to all concerned that these bonds went through all the necessary steps of the routine from receipt at the vaults to delivery to the post office with-

out the loss so far as is now known of a single piece by the Treasury organization.

Needless to say, in order to achieve this result, extreme care and frequent verifications were necessary. The bonds were delivered to the main vault, located not far from the 195 Broadway offices, where complete count was made by designated officials. Great care was exercised in their subsequent transfer to the secondary vaults for counter delivery at 195 Broadway, and for the mailing unit located in the Federal Reserve Bank Building. Upon their receipt there and again prior to their dispatch to subscribers either by mail or by delivery at the counter, additional verifications were effected. In mailing, special precautions were taken in order that the bonds be allotted in the correct amount and in the correct denominations. To insure such accuracy each subscription was handled by two persons: the first man counting the bonds and recording the allotments to the individual subscribers, and the second man verifying the allotments and enclosing the bonds in envelopes. After final verification, the 130,000 specially manufactured envelopes needed for mailing the bonds had to be sealed by hand, an operation which required fifty gallons of mucilage.

The affixing of the postage to such a quantity of registered mail was accomplished in a unique and unusually efficient manner through the use of newly developed postage meter machines. These machines, which were the first of their kind to be put in practical operation, were specially adapted for the use of the American Company on this work, being so adjustable as to imprint on the envelopes varying amounts of registered postage according to the different weights of the individual pieces of mail involved. Besides being speedier than the old method of affixing stamps by hand, these machines eliminated the problem of maintaining a supply of registered mail stamps in varying amounts and accounting for their use, since the meters attached

to the machines automatically recorded this. In all, over \$24,000 meter postage was imprinted.

The convertible bond issue, the largest piece of Bell System financing, was in all respects a success. The financial press spoke well of the issue, a substantial interest was manifested by bankers and brokers, and a wide-spread distribution of the bonds was obtained which has broadened the investment interest in the business. The stockholders were aware or were made aware of the value of their rights to such an extent that only a negligible percentage was allowed to lapse, and many pleasant public relations contacts were established in all parts of the country through Bell System employees. Sincere appreciation is due these employees, both permanent and temporary, who contributed to the success of the issue by their loyal and effective work.

H. BLAIR-SMITH

## Listening Device Aids in Combating the Fruit Fly Pest in Florida

EDITOR'S NOTE: *Surveying every field of scientific endeavor to find means to combat the ravages of the Mediterranean fruit fly, it occurred to the entomologists of the Bureau of Plant Industry, U. S. Department of Agriculture, that the presence of the larvae within the fruit might be detected by a sensitive electrical stethoscope.*

*Dr. David Fairchild of the Department of Agriculture asked President W. S. Gifford of the American Telephone and Telegraph Company for assistance in the very urgent problem at hand. A deputation from the Technical Staff of the Bell Telephone Laboratories, with appropriate apparatus, was promptly sent to Florida.*

*The story of the application of telephone research to the study of a problem in nowise connected with communication is told by Mr. D. G. Blattner who was in charge of the work.*

THE business of being a telephone engineer sometimes leads to unusual experiences far afield of the telephone business. Such experiences usually result from the interest shown by the Bell System in the problems of the public, and from the intense interest on the part of the public in the many communicational developments that are going on about us. It was, therefore, not surprising that when the government entomologists discovered the presence of the dreaded Mediterranean fly in the Florida citrus fruit district that they should have called upon the Bell System for assistance.

The Mediterranean fruit fly was first observed in fruit from the Azores about a hundred years ago and



since that time the growing of fruits that serve as hosts to the pest has been seriously handicapped the world over except in continental United States. The discovery of the pest in the United States might, therefore, be reasonably expected to cause alarm. Moreover, when it is recalled that the list of fruits that serve the fly as hosts is a long one, including practically all of our common fruits, and many of our vegetables, it is no wonder that every possible facility for combating the pest should have been resorted to.

The Mediterranean fruit fly is similar in size and general appearance to the common house fly except for its markings, its general adaptability to its own particular purposes, and its vastly greater hardiness. In appearance it has a series of brownish yellow stripes across the body and wings, and altogether, might be considered as rather chic. As to its adaptability and hardiness, it appears that the female is able to deposit her eggs at just the proper depth below the fruit rind regardless of the thickness of the rind and while the fly cannot withstand freezing temperatures, it appears to be able to stand temperatures about as low as the fruit that it attacks. As for its likes and dislikes, it appears to have no difficulty in choosing the fruit most to its liking and while as a larva it appears to have well defined ideas about how a respectable larva should pupate, it can and will adapt itself to almost any condition which may be imposed upon it. The whole life cycle of the fly may take place within a period of from two weeks to six months, depending upon the conditions, and one fly has been known to lay as many as 800 eggs. If it is assumed that for such favorable conditions as exist in Florida the complete life cycle takes place in a month, and that the fly as such lives to an age of four months and produces an average of 400 eggs, half of which hatch out to be females, a single fly might produce a horde of about 35,000,000,000 members in a period of six months except for deaths in the family from time

to time. In other words, if every person in the United States were to eat an orange a day, it would require a year for the present population to consume as many as this one fly and her offspring might destroy in six months from the date of her maturity.

The destruction of the fruit by the Mediterranean fly is accomplished during the larva stage of development. Because of its "Volsteadian" sentiments, the larva, unlike many other larva, completely riddles the fruit in its efforts to keep in advance of the fermentation of the fruit juice that accumulates about it. To enable it to make rapid progress in its burrowing it is equipped with two spine-like hooks with which it tears the tissue. It occurred to the entomologists on the job that perhaps the Bell System might be able to provide apparatus by means of which the tearing of the fruit tissue might be detected. The situation was brought to the attention of President Walter S. Gifford of the American Telephone and Telegraph Company by Dr. David Fairchild of the United States Department of Agriculture and the present writer with one of his associates were dispatched from the Bell Telephone Laboratories to Orlando to see what might be done.

In consideration of the problem it seemed reasonable to expect that the larvæ might expend energy in the fruit in any of the following forms:

1. Acoustic effects from the larva direct.
2. Heat liberated as a result of the activity of the larva.
3. Muscular electrification of the larva.
4. Mechanical vibration of the fruit tissue caused by the larva.

Of these, the first two forms were considered to be unimportant as a telltale of the presence of the larvæ. The sound generated, as heard in the fruit, would probably be very limited in amount and the fruit structure is not a good sound transmitting medium while the heat generated would be so small in amount and the thermal

capacity of the fruit so large, that the temperature change would probably be negligibly small. As for electrification, it would seem that the chances of success would be reasonably good when it is recalled that the electrification of some of the smaller muscles of the human eye is of the order of several microvolts. In regard to vibrational energy it would seem that a reasonable amount of vibration might be produced and that it would be transmitted throughout the whole structure of the fruit with reasonable facility. Further it would be expected that the character of the vibrations would be determined by the fruit structure rather than by the maggot so that the sounds would not vary with the size of the maggot. Because of these considerations, it appeared that our chances of success would be best if our efforts were directed along the lines of the electrification and the vibration effects.

As for apparatus that might be used in detecting vibrational effects, we were in a rather happy position. The electrical stethoscope, an instrument developed a few years ago to aid in the instruction and training of student physicians and to assist older physicians whose hearing has become somewhat impaired, seemed to be admirably suited for this particular problem. It was planned that a fruit suspected of being infested would be placed upon the stethoscope transmitter supported on a vibrationless support, that the amplifier would be turned on and such of the filters in the stethoscope as might seem most suitable would be switched in to exclude extraneous noises. The results would be observed by listening to a telephone receiver. In case the maggot sounds could not be heard at the surface of the fruit it was planned to replace the stethoscope transmitter by a special electro-mechanical reproducer used in theatre sound-reproducing systems and designed with a long needle which might be inserted well into the fruit. Also laboratory work involving the use of an amplifier designed to give particularly low tube-noise

and very great sensitivity was temporarily suspended in order that we might have this device to use in case the stethoscope amplifier was found to be unsatisfactory.<sup>1</sup>

Upon arrival in Orlando, we found that the entomological forces had been highly organized for action, that the national guard had been called out to aid in carrying out the rather extreme measures that had been decided upon, and that having an infested fruit in one's possession was considered a grave offense. In spite of these difficulties, however, we succeeded in getting a few pieces of fruit that were thought to be infested and the battle was on. Out of the first four such fruits, three were found to be "noisy" and the fourth one was "quiet." After demonstrating the sounds to the various entomologists on the job, two of the "noisy" fruits were opened and found to contain active larvæ while the "quiet" one was found to contain none.

Having thus shown the possibility of hearing the larvæ inside the fruit, the question was raised as to how the detecting apparatus might be used to best advantage. It was obvious from the start that as a means of inspection of fruit for market, it would not be satisfactory because of the time and expense involved. It was found that the larvæ were more active at certain times of the day than at others and that during the active periods they work more or less intermittently. Testing of fruit would, therefore, have to be done only at certain times and if the test lasted only a moment there would be no assurance that the larvæ might not be resting at that particular moment. The listening apparatus appeared to offer the greatest possibility of service, rather, as a means of carrying on certain researches. At the present time, means for controlling or eliminating the pest are being worked out on the basis of submitting a fruit to the ravages of the pest for a limited time, after which it is opened for observation.

<sup>1</sup> Test data indicate that the larva produces vibrations at the surface of the fruit of the order of a hundredth of a millionth of a centimeter.



The difficulty with such a method is that each individual test is necessarily terminated after the first observation. By means of the listening apparatus, it would be possible to continue the test on each particular sample for such duration of time as might seem desirable.

D. G. BLATTNER.

## Abstracts of Technical Papers from Bell System Sources

*Reciprocal Theorems in Radio Communication*,<sup>1</sup> by John R. Carson. Two reciprocal theorems, the generalized Rayleigh theorem and the Sommerfeld-Pfrang theorem, are of great theoretical importance in radio communication. A careful analysis of these theorems and their mathematical derivations shows that they are quite distinct and their practical fields of application different. In particular it shows that the Sommerfeld-Pfrang theorem labors under restrictions, implicit in its mathematical derivation, which seriously limit its field of practical applicability.

*Telephone Circuits for Program Transmission*,<sup>2</sup> by F. A. Cowan. Systems of telephone circuits which are extensively used in the transmission of programs to broadcasting stations are described in this paper. Certain stages in the development of these systems are considered and the general requirements for satisfactory transmission at the present time are enumerated. The arrangements of the systems as well as the procedures used in setting up and maintaining them are discussed.

*Correlation of Directional Observations of Atmospherics with Weather Phenomena*,<sup>3</sup> by S. W. Dean. This paper analyzes some data on the direction of arrival of static at Houlton, Maine, obtained by means of a recorder and a cathode ray radio direction finder; and points out that in certain cases there is a relation between the direction of static and the location of storm

<sup>1</sup> Proceedings of the Institute of Radio Engineers, Vol. 10, June, 1929, pp. 952-956.

<sup>2</sup> A. I. E. E. Journal, July, 1929, pp. 538-542 (abridgment).

<sup>3</sup> Proceedings of the Institute of Radio Engineers, Vol. 17, July, 1929, pp. 1185-1191.

centers. Two cases are discussed in which day by day bearings showed static sources in the direction of moving storm centers.

*A Direct-Current Amplifier for Measuring Small Currents*,\* by J. M. Eglin. A direct-current amplifier consisting essentially of a Wheatstone bridge, having the amplifying tube in one arm and a balancing tube in another, has been described by P. I. Wold and by C. E. Wynn-Williams. This circuit has now been developed to give a constant amplification for currents in either direction up to 10,000 times the lowest measurable value. The amplification and the lowest measurable current are alterable together by changing the resistance introduced between the grid and filament of the amplifying tube. With tubes of high insulation, the amplification can be made as large as  $10^6$ ; and the measurable current as low as  $10^{-14}$  ampere. Some improvements of the circuit are: (1) the insertion of a resistance in series with the tube in one arm of the bridge to "compensate" for variations in plate and grid battery voltages; (2) the suspension of the tubes to protect them from mechanical vibrations; (3) the use of tubes with pure tungsten filaments to avoid changes in contact potentials, and with plates enclosing the filaments completely to lower the effects of wall charges. In a "null" method of using the circuit the values of the grid resistance and an auxiliary potential introduced in the grid-filament circuit are sufficient to determine the measured current.

*Meeting Long Distance Telephone Problems*,<sup>5</sup> by H. R. Fritz and H. P. Lawther, Jr. There have been written many papers describing various technical and apparatus developments of value in providing long distance telephone service. Several papers have also appeared covering specific transmission or operating

\* Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 18, May, 1929, pp. 393-402.

<sup>5</sup> A. I. E. E. Journal, July, 1929, pp. 547-550 (abridgment).

problems, or dealing with the advance planning of the telephone plant. Feeling that it might be of interest, particularly to the young engineering graduates, the writers have prepared this overall sketch of the general problem of actually providing, year by year, the extensions and additions to a comprehensive network of communication channels necessary to keep pace with a growing public demand for long distance service. Since the writers are most familiar with the area served by the Southwestern Bell Telephone Company, the discussion is restricted to that territory.

*Some Measurements on the Directional Distribution of Static,*<sup>6</sup> by A. E. Harper. The utility of directional data on static is shown, and two types of apparatus devised for such a directional investigation are compared. It is shown that a method which gives the direction of individual crashes is superior to integrating methods. The distribution of thunderstorms over the world is discussed, and comparisons are drawn between this distribution and the observed directional distribution of static. Probable geographical locations are assigned to the sources, based upon thunderstorm data and directional observations.

*Maximum Excursion of the Photoelectric Long Wave Limit of the Alkali Metals,*<sup>7</sup> by Herbert E. Ives and A. R. Olpin. Earlier experiments have shown that the long wave limit of photoelectric action in the case of thin films of the alkali metals varies with the thickness of the film. A maximum value is attained greater than that for the metal in bulk, which for the majority of the alkali metals lies in the infra-red. The wavelength of the maximum excursion of the long wave limit was first studied for Na, K, Rb and Cs. In each case it was found to coincide with the first line of the prin-

<sup>6</sup> Proceedings of the Institute of Radio Engineers, Vol. 17, July, 1929, pp. 1214-1224.

<sup>7</sup> Physical Review, Vol. 34, July 1, 1929, pp. 117-128.



cipal series, i.e., the resonance potential. If this relation holds for lithium, its maximum long wave limit should be greater than that of sodium. This was tested and confirmed by experiments in which red-sensitive lithium films were prepared, sensitive to  $0.6708\mu$ . It is suggested that photoelectric emission is caused when sufficient energy is given to the atom, to produce its first stage of excitation. The identity of photoelectric and thermionic work functions suggests that atomic excitation is the initial process in thermionic emission as well.

*Magnetic Testing Furnace for Toroidal Cores,*<sup>8</sup> by G. A. Kelsall. When making magnetic tests at high temperatures trouble is often experienced in maintaining the insulation between turns of the magnetizing and exploring windings and between the windings and the test sample.

This paper describes a magnetic testing furnace for toroidal specimens which eliminate these difficulties. By means of this furnace the test sample may be passed through a definite temperature cycle and the variation in magnetization for a constant magnetizing force determined or the temperature may be held constant while measurements are made for the B-H curve or for a hysteresis loop.

*Electrical Wave Analyzers for Power and Telephone Systems,*<sup>9</sup> by R. G. McCurdy and P. W. Blye. This paper describes two types of electrical analyzers which have been developed for the direct measurement of harmonic components of voltage and current on power and telephone systems. These devices are assembled mechanically in a form suitable for use either in the laboratory or in the field. Both instruments, which differ chiefly with respect to sensitivity and input circuit arrangement, employ multistage vacuum

<sup>8</sup> Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 19, July, 1929, pp. 47-49.

<sup>9</sup> A. I. E. E. Journal, Vol. 48, June, 1929, pp. 461-464 (abridgment).

tube amplifiers and two duplicate interstage selective circuits.

The power circuit analyzer is designed to measure harmonic voltages in the frequency range from 75 to 3000 cycles and over a voltage range from 0.5 millivolt to 50 volts. The telephone circuit analyzer operates over the same frequency range and measures harmonic currents as low as 0.05 microampere and voltages as small as 0.005 millivolt. Both analyzers are adapted to measure small harmonic voltages and currents in the presence of the fundamental component and other harmonics relatively large in magnitude.

A number of devices are described which have been adopted for eliminating various sources of error. The paper presents in detail the characteristics of both instruments with respect to selectivity, sensitivity, linearity, balance of input with respect to ground, generation of harmonics, and susceptibility to stray fields.

*Solution to a Problem in Diffusion in Employing a Non-Orthogonal Sine Series*,<sup>10</sup> by R. L. Peek, Jr. In this paper are described some recent developments in to diffusion through a membrane between a chamber in which a constant pressure of the diffusing material is maintained and a second closed chamber, initially evacuated, into which the material diffuses. Assuming Fick's law to apply, a solution is obtained in the form of an infinite series of a type similar to those applying to other problems in diffusion. The sine series to which the solution reduces at zero time is non-orthogonal, but it is shown that by a modification of Fourier's method the coefficients of the terms may be directly determined. There is included a proof of the convergence of the series considered.

*Recent Developments in Telephone Construction Practices*,<sup>11</sup> by B. S. Wagner and A. C. Burroway. In this paper are described some recent developments in

<sup>10</sup> *Annals of Math.*, 2d Series, Vol. 30, April, 1929, pp. 265-269.

<sup>11</sup> *A. I. E. E. Journal*, Vol. 48, May, 1929, pp. 366-369 (abridgment).

telephone cable installation and maintenance practices. The paper is divided into three sections: (1) Gas pressure testing for detecting and locating sheath defects before they result in failure. (2) Methods for reducing bowing and other movements of cable which in time cause fracture of the sheath. (3) Catenary construction for long spans, such as at river crossings.

*A Method of Sampling Inspection*,<sup>12</sup> by H. F. Dodge and H. G. Romig. This paper outlines some of the general considerations which must be taken into account in setting up any practical sampling inspection plan. An economical method of inspection is developed in detail for the case where the purpose of the inspection is to determine the acceptability of discrete lots of a product submitted by a producer. By employing probability theory, the method places a definite barrier in the path of material of defective quality and gives this protection to the consumer with a minimum of inspection expense.

*Statistical Theories of Matter, Radiation and Electricity*,<sup>13</sup> by Karl K. Darrow. In this paper is discussed the atomic or kinetic theory of gases which has ranked for over half a century as one of the triumphs of theoretical physics. Owing to brilliant new work in the fundamentals of statistical theory, a competent kinetic theory of radiation and of electricity in metals now exists beside its predecessor, and perhaps even includes it.

*Articulation Testing Methods*,<sup>14</sup> by H. Fletcher and J. C. Steinberg. This paper is chiefly concerned with the technique of making articulation tests. The construction of a syllabic testing list, the selection of a testing crew, the methods of comparing articulation data for various crews, and the significance of the test as a measure of the speech capabilities of a system are

<sup>12</sup> Bell System Technical Journal, October, 1929.

<sup>13</sup> Physical Review Supplement, Vol. 1, July, 1929, pp. 90-155.

<sup>14</sup> Bell System Technical Journal, October, 1929.

discussed. Various types of lists for different uses are also discussed.

*The Frequency Distribution of the Unknown Mean of a Sampled Universe*,<sup>15</sup> by E. C. Molina and R. I. Wilkinson. In this paper the mathematical analysis is based on the Laplacian Bayes Theorem which implicitly comprehends the results of a sample together with the a priori knowledge available concerning the parameters of the universe.

The discussion is limited to a universe assumed to be normal but whose mean and precision constant are unknown. Several simplifying, yet quite reasonable, assumptions regarding the forms and independence of the a priori frequency distribution of the true mean and standard deviation are incorporated in the analysis so that numerical answers may more easily be deduced.

Conclusions, properly drawn, are usually quite definitely dependent upon the a priori assumptions made, and especially so in the case of small samples. A considerable space is, therefore, devoted to the solution of a problem in which the sample is only five, taking up a wide variety of these a priori assumptions. They give, in consequence, a wide range of numerical results, appearing in the form of probable errors in the mean of the sample. Each set of assumptions is briefly discussed indicating how the sampling technician may be able to make a selection consistent with his a priori knowledge of a particular problem.

*Telephone Transmission Networks*.<sup>16</sup> *Types and Problems of Design*, by T. E. Shea and C. E. Lane. In this paper a brief résumé of the nature of telephonic signals is given, showing how the qualities of wave composition which distinguish signals from other electrical waves set the requirements on networks and provide a basis for their design.

<sup>15</sup> Bell System Technical Journal, October, 1929.

<sup>16</sup> Presented at the Regional Meeting of the South West District No. 7, of the A. I. E. E., Dallas, Texas, May 7-9, 1929. Abridgment in A. I. E. E. Jour., Aug., 1929.



The principal functions of wave filters, equalizers, telephone transformers, line balancing networks, and artificial lines are outlined. In order that these networks may be used in conjunction with other apparatus in the telephone system they must provide efficient transmission, low distortion, good impedance balance, stoppage of longitudinal currents, stable characteristics with current variations, low external coupling, and low reflection coefficient. In addition to these requirements the network must not cross-talk into associated circuits and must have desirable impedance characteristics in the attenuation range of frequencies as well as throughout the transmission range.

An illustration of the use of transmission networks in a typical three-channel carrier telephone system is given describing the functions of the line filter sets, the directional filter sets, band filters, and equalizers.

Some of the engineering limitations on the design and construction of networks are discussed.

*Speech Power and its Measurement*,<sup>17</sup> by L. J. Sivian. This paper is chiefly concerned with the important speech power quantities—frequency spectra, distributions of instantaneous, average, syllabic and peak amplitudes, etc.—as they obtain in actual speech for a large range of voices, talking levels, and subject matters. The analysis is not nearly so complete nor so fine-grained as that which, in principle, can be derived from oscillographic records of individual speech sounds. Its advantage is in the speed with which data can be secured, under widely varying conditions and on a scale which warrants statistical conclusions. Some of the methods in use for measurements of this type are described. A “level analyzer” has been developed, primarily for the measurement of average and peak pressure amplitudes in speech and music, both as to magnitude and as to position in the frequency spec-

<sup>17</sup> Bell System Technical Journal, October, 1929. Presented before Acoustical Society of America, May 11, 1929.

trum. Illustrative results are given for samples of speech, music and noise.

*Physical Properties and Methods of Test for Some Sheet Non-Ferrous Metals*,<sup>18</sup> by J. R. Townsend and W. A. Straw. This paper covers an investigation which was undertaken to secure a simple and reliable method of test for sheet non-ferrous metals. An account of the early development work leading to the adoption of the Rockwell hardness tester for a preliminary inspection of sheet metals and the tensile test as the basic test to be referred to in case the Rockwell test results were near to or outside the established Rockwell limits for a given lot of material was published in 1927. The continuation of this work including establishment of test limits for four grades of brass and for two grades each of nickel silver and phosphor bronze will be published this year. This present paper describes the development work reported by these two papers.

Considerable attention has been given to the Rockwell tester, which, as a result of this work, has been found satisfactory for use as a specification instrument for brasses 0.020 in. and thicker, when used under standardized methods of test and calibrated with standard test blocks. Other tests such as the bend test, ductility test and other hardness tests have been studied but further development work is necessary.

The Rockwell hardness and tensile strength limits are given for four alloys of brass, and two alloys each of nickel silver and phosphor bronze. The physical properties of the rolling series upon which these limits were based are presented as well as experience data obtained on shipments of commercial material. The limits for brass alloys A, B and E are considered final, but the limits for the other metals are tentative until more complete experience is available.

Grain size limits are given for annealed brass and nickel silver sheet. For inspection purposes the grain

<sup>18</sup> Bell System Technical Journal, October, 1929.

size is estimated by comparison with the standard photomicrographs reproduced in the 1929 report of Committee E4 of the A. S. T. M. on Metallography.

Refinements in the calibration of the Rockwell tester are given, as well as the development of testing technique. An experimental model of a motor-driven bend test machine is described.

*Asymptotic Dipole Radiation Formula*,<sup>19</sup> by W. Howard Wise. In this paper the asymptotic dipole radiation formulas given by Weyl, the Reciprocal Theorem and Strutt are obtained by refining Sommerfeld's analysis.

<sup>19</sup> Bell System Technical Journal, October, 1929.

## Notes on Recent Occurrences

### TELEVISION IN COLORS

A SCORE or more of New York newspaper men, gathered in the Bell Laboratories on June 27, witnessed the first public demonstration of color television—the transmission and reproduction by electricity of moving objects in their natural colors. Through the television apparatus they saw a fluttering red, white and blue American flag; a child's playball; bright with orange, green and red; a bouquet of roses; a slice of watermelon; and—as a sort of a finale—a young woman, clad in a costume that suggested a Hallowe'en party, who smiled while she toyed with a string of red coral beads.

Television in color is an American achievement. It is the accomplishment of the same group of Bell System engineers, headed by H. E. Ives, who gave the first public demonstration of successful single-color television, about two years ago. A second step in the Bell System's development of television was accomplished last summer, when scenes illuminated by ordinary sunlight were successfully transmitted.

Much of the apparatus employed in color television is essentially the same as that used in the one-color demonstration of April, 1927. The only new features of the apparatus are the type and arrangements of the photo-electric cells at the transmitting end, and the type and arrangements of the neon and argon tubes at the receiving end.

### CELLS THAT CAN "SEE" COLORS

The photo-electric cells used in monochromatic television were sensitive only to the blue-green end of the spectrum and were, so to speak, "color blind" as to red



values. A new type of cell, using sodium in place of potassium, has been developed, and has proved responsive to all of the colors of the visible spectrum, including the deep reds. In combination with the scanning apparatus, these cells perform the function of "looking at" the scene or object to be transmitted and for this reason are sometimes referred to as "electric eyes."

So far as the eye is concerned, any color may be represented by the proper combination of just three fundamental colors—red, green and blue. The first problem in the development of color television was, therefore, that of arranging sets of photo-electric cells in such a manner that one set would be responsive to the red values, another to the greens, and a third for the blues. This has been accomplished by the use of color filters made up of sheets of colored gelatin. Three sets of cells, each with its appropriate filters, are employed and three series of television signals are generated, instead of one as in the case of monochromatic television. Three channels are used for the transmission of these signals, one for each fundamental color.

#### NEON AND ARGON LAMPS

At the receiving end, three lamps are used, one for each fundamental color. The red-glowing lamp is filled with neon gas and is essentially similar to those previously used in one-color television. The sources of green and blue lights are argon tubes. In order to combine the light of the three lamps, so that they may be viewed through the scanning disc as if coming from the same point, two semi-transparent mirrors are interposed between them and the disc.

Behind the scanning disc, in addition to the lamps and mirrors, is a lens system which focuses the light into a small aperture at the front of the apparatus. The observer looking into the aperture receives, through each hole of the disc as it passes the aperture, light from

the three lamps—each controlled by its appropriate signal from the sending end. When the intensities of the three images are properly adjusted, he therefore sees an image in its true colors, with the general appearance of a small colored motion picture.

### TRANSATLANTIC SERVICE EXTENSIONS

**T**RANSATLANTIC telephone service was extended to Belfast in Northern Ireland, to Dublin in the Irish Free State and to the Isle of Man on August 26th. On August 28th it was extended to Milan, Italy, and a few weeks later it was further extended to Turin and to Genoa, the birthplace of Columbus. On October first it was extended from Prague to include all of Czecho-Slovakia.

The rate for a telephone conversation between New York City and these points in Ireland is \$46.50 for the first three minutes and \$15.50 for each additional minute. The rate between New York and any of the three Italian cities is \$51 for the first three minutes and \$17 for each additional minute.

Calls from America to Ireland are routed through New York City to one of the Bell System's radio transmitting stations, across the Atlantic to a receiving station in Great Britain and thence by wire to London. From London telephone wires carry the calls to submarine cables running under the Irish Sea.

Connection with the Irish Free State is established through a cable between Nevin in Carnarvonshire, Wales, and Howth in County Dublin. A cable between Port Mora on the Stranraer Peninsula in Wigtownshire, Scotland and Donaghadee in County Down connects Northern Ireland with the mainland. The Isle of Man is linked by a new cable from Blackpool in Lancashire to Douglas on the island. An extension of the latter cable will ultimately provide new direct circuits between London and Belfast. There are about 47,000 telephones in Ireland.

Calls from America to Italy will be transmitted to London over the same route as other transatlantic calls. From London telephone wires will carry the calls to submarine cables under the English Channel. From the Channel telephone wires will again carry the calls across France and Switzerland. In all the messages will travel over a circuit of approximately 4,400 miles.

Milan, Turin and Genoa have a total of more than 100,000 telephones and a combined population of nearly two million. These extensions put the American telephone user in voice communication with twenty-one foreign countries.

#### TRANSATLANTIC SERVICE PLACED ON 24-HOUR BASIS

**T**O meet the requirements of a constantly increasing traffic, transatlantic telephone service was put on a twenty-four hour basis beginning September 10th. The round-the-clock service extends to all points in Europe connected to America by the overseas circuits. For the past year the daily service period has been from 6:30 A.M. to 10 P.M., New York time.

When the service was first inaugurated between New York and London on January 7, 1927, the period of service was from 8:30 o'clock in the morning to 1 P.M., Eastern Standard Time. Later, on April 10 of the same year, this period was extended from 7:30 A.M. to 1 P.M., Eastern Standard Time. Another hour in the morning was added on April 24, and shortly thereafter the time was extended in the afternoon to 5 P.M. and subsequently to 6 P.M.

On March 4, 1928, coincident with the reduction of rates, the period of operation was extended to 8 P.M., Eastern Standard Time, and on June 4, 1928, it was made available up to 9 P.M., Eastern Standard Time. This was further extended to 10 P.M. on September 30, 1928.

Effective September 10, 1929, the service became continuous. The differences in international time, which between California and middle Europe amount to nine hours, hitherto had interfered with the full use of the service, but this has now been corrected by the change in the hours.

## BELL SYSTEM OFFICIALS TELEPHONE TO AUSTRALIA

America talked with Australia through regular telephone instruments for the first time on September 25th when officials of the American Telephone and Telegraph Company exchanged greetings with the Australian telephone officials in Sidney. The occasion was an informal demonstration of the practicability of connecting the transatlantic telephone channel operated by the American Telephone and Telegraph Company and British Post Office with the new short wave radio telephone channel operated by the British General Post Office between Great Britain and the Australian Continent. The directive short wave transatlantic radio channel that is now in regular use for European service was used in the demonstration instead of the long wave channel so that the voices of the speakers were carried a total distance of 15,000 miles by the short wave system of transmission interconnecting the wire systems of the United States and Australia.

From the office of President Walter S. Gifford of the American Telephone and Telegraph Company calls passed over wire lines to the company's short wave transmitting center at Lawrenceville, N. J.; thence by radio to the short wave receiving station of the British General Post Office at Baldock near London, England; and thence by wire via London to the British Government's transmitting station at Rugby, England, and again by radio to the receiving station of Amalgamated Wireless of Australia, near Sidney. The return path



was again to Baldock; thence via Rugby to the Bell System's short wave receiving station at Netcong, N. J.

An interesting aspect of the conversations was that, taking place at four o'clock, September 25, New York time, the clocks in Sidney read six A.M., September 26.

The conversations were between President Gifford of the American Telephone and Telegraph Company, Dr. Frank Jewett, President of the Bell Telephone Laboratories, Vice President Arthur W. Page, American Telephone and Telegraph Company, and T. G. Miller, General Manager Long Lines, American Telephone and Telegraph Company, on the American side; and Mr. A. S. MacDonald of Amalgamated Wireless of Australia.



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